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# **JOURNAL OF THE URBAN PLANNING AND DEVELOPMENT DIVISION**

PROCEEDINGS OF  
THE AMERICAN SOCIETY  
OF CIVIL ENGINEERS





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OF CIVIL ENGINEERS



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The key words, abstract, and reference "cards" for each article in this Journal represent part of the ASCE participation in the EJC information retrieval plan. The retrieval data are placed herein so that each can be cut out, placed on a 3 × 5 card and given an accession number for the user's file. The accession number is then entered on key word cards so that the user can subsequently match key words to choose the articles he wishes. Details of this program were given in an August, 1962 article in CIVIL ENGINEERING, reprints of which are available on request to ASCE headquarters.

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## 16626 ENVIRONMENTAL ASSESSMENT IN ONTARIO, CANADA

**KEY WORDS:** Environmental engineering; **Environmental Monitoring;** **Environmental planning;** **Legislation;** Project management; **Project planning;** **Urban planning**

**ABSTRACT:** The environmental assessment process in Ontario, Canada, is described and critiqued as an anticipatory, comprehensive planning process required for all public and designated major private projects. With examples from National Environmental Policy Act (1969) litigation, the discussion indicates that goals of comprehensiveness and objectivity may not be fully realized, partly due to a number of interpretative problems identified in The Environmental Assessment Act (Ontario, 1975). In addition, a review of the environmental assessment and project approvals process infers that the process may be difficult to administer and coordinate. An examination of the future direction of environmental assessment reveals an attempt, at the municipal level, to integrate environmental assessment with existing planning and environmental legislation.

**REFERENCE:** Curtis, Frederick A. (Asst. Prof., School of Urban and Regional Planning, Queen's Univ., Kingston, Ont., Canada), "Environmental Assessment in Ontario, Canada," *Journal of the Urban Planning and Development Division, ASCE*, Vol. 107, No. UP1, **Proc. Paper 16626**, November, 1981, pp. 1-17

## 16667 FUNCTIONAL PLANNING TOOL: TOURISM IMPACT MODEL

**KEY WORDS:** **Econometric models;** **Economic impact;** Input-output analysis; Regional analysis; Regional development; **Tourism**

**ABSTRACT:** The Tourism Impact Model (TIM) is an economic modeling technique that structures the existing relationship between tourism expenditures and various economic impacts. It provides a system of average impact multiplier linkages relating the tourism expenditures to some economic consequences. The model also considers the intermediate impact of capital investment induced by tourism activity. There are two basic types of equations comprising the TIM. One set is the various sectoral investment functions, which are estimated econometrically. The investment equations estimate the expected capital feedback resulting from current economic activity. The second set is current economic impact equations. The parameters of these latter equations are derived from the regional input-output model which determine the levels and the distributions of the various total economic resources required to satisfy a given final demand (expenditures) in the tourism sectors.

**REFERENCE:** Fritz, Richard G. (Asst. Prof. of Economics, Univ. of Central Florida, Orlando, Fla.), and Konecny, Mike, "Functional Planning Tool: Tourism Impact Model," *Journal of the Urban Planning and Development Division, ASCE*, Vol. 107, No. UP1, **Proc. Paper 16667**, November, 1981, pp. 19-31

## 16670 IMPACTS OF EPA'S CONSTRUCTION GRANTS PROGRAM

**KEY WORDS:** **Environmental Protection Agency;** Financing; **Grants;** **Impacts;** Land use; **Local government;** Planning; Sewage treatment; **Wastewater treatment;** Water quality

**ABSTRACT:** The massive expenditures under the EPA'S Construction Grants Program could have significant impacts on local populations and development, especially since Construction Grants projects are not required to consider actions to mitigate resulting secondary impacts. Many opportunities to use wastewater facility construction to complement other local objectives are underutilized because meeting water quality improvement requirements is the only objective used in planning of Construction Grants projects. The reluctance of many cities to undertake wastewater facility construction results from local priorities for capital investments, not from an absolute inability to pay. No correlation between current fiscal condition and total per capita wastewater facility needs was found.

**REFERENCE:** Noss, Richard R. (Asst. Prof. of Civ. Engrg., Univ. of Massachusetts, Amherst, Mass.), and Marks, David H., "Urban Impacts of EPA's Construction Grants Program," *Journal of the Urban Planning and Development Division, ASCE*, Vol. 107, No. UP1, **Proc. Paper 16670**, November, 1981, pp. 33-48

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## ENVIRONMENTAL ASSESSMENT IN ONTARIO, CANADA<sup>a</sup>

By Frederick A. Curtis<sup>1</sup>

### INTRODUCTION

The incorporation of environmental considerations into the planning process is a legal requirement for public and designated major private projects proposed in Ontario, Canada. To ensure that environmental considerations are integrated into planning and decision-making, before approval of projects of public and environmental significance is given, the government of Ontario has initiated a preventative, comprehensive, and coordinated approach to project planning, i.e., environmental assessment.

Environmental assessment has emerged as an important planning and decision-making process to complement existing pollution abatement methods and environmental statutes. The shift to a preventative approach for environmental protection is defended on the basis that it is more economical, effective, and efficient to integrate environmental objectives at the project planning stage, rather than incorporate pollution abatement methods after project implementation, or invoke environmental legislation to ameliorate pollution and protect natural resources.

Environmental assessment is comprehensive in approach in that natural environment aspects are given equal consideration with social, economic, cultural, energy-related, engineering, and other project aspects. All these are integrated into the planning process and reflected in a single document which is reviewed by the government prior to the undertaking being allowed to proceed.

Environmental assessment utilizes a coordinated approach to decision-making, where the emphasis is on resolving divergent conflicts and opinions among all interests throughout the course of the review process for the environmental assessment document. In addition, emphasis is placed on coordinating the project approvals process involving existing planning and environmental legislation.

The objective of this paper is to describe and assess environmental assessment as an integrated approach to project planning at the provincial and municipal

<sup>a</sup>Presented at the September 23-29, 1979, International Conference on the Environment: Methods and Strategy for Integrated Development, held at Arlon, Belgium.

<sup>1</sup>Asst. Prof., School of Urban and Regional Planning, Queen's Univ. Kingston, Ont., Canada.

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levels in Ontario. Environmental assessment is discussed in terms of its development, legal and administrative requirements, areas of improvement, and future direction.

#### ENVIRONMENTAL ASSESSMENT ACT: A BRIEF HISTORY

In 1972, the government of Ontario developed policy proposals on environmental assessment, "to protect, conserve and manage the environment and improve the quality of life in Ontario." Before proceeding with this initiative, the government published the *Green Paper on Environmental Assessment*, which indicated the rationale for environmental assessment and different options for preparing and reviewing the environmental assessment document (EA) (15).

After 2 yr of public discussion and in-house analysis, the Environmental Assessment Act (EAA) 1975, was given first reading in the legislature (11). Following a number of very substantial amendments, the proposed act received third and final readings. The act subsequently received royal assent, and was proclaimed on October 20, 1976.

The central purpose of the act is to ensure the following:

1. The identification and evaluation of all potentially significant environmental effects of proposed undertakings early in the planning process.
2. Consideration be given to the means of avoiding or mitigating any adverse environmental effects prior to granting any approval to proceed with an undertaking.
3. Public involvement at a stage when options are still open.

#### APPLICATION OF ENVIRONMENTAL ASSESSMENT ACT

**Public Projects.**—The EA was proclaimed in force for all public sector projects, with the provision that certain projects be exempted where a case could be made that the application of the act would result in damage or interference.

Under Ontario Regulation 836/76, which provided the operational mechanism for the application of the act to public projects, municipalities and conservation authorities were granted exemptions in order to allow time for EA procedures to be developed and streamlined for provincial government projects (18). The exemption was also intended to allow time for discussions between parties on which municipal and conservation authority projects would be subject, as well as to discuss phasing-in mechanisms. The Conservation Authority regulation came into force on September 1, 1977.

At present, 12 Ontario ministries are exempt from the act. In addition, projects planned by Ontario ministries, which cost less than \$1,000,000, have been exempted. To date, about 150 projects subject to the act have been exempted where the proponent—the person(s) proposing to implement the project—has argued that the government or the public, or both, will be interfered with, or an undue delay or expense, or both, will occur, or the anticipated adverse environmental effects are not expected to occur.

A sample list of projects subject to the act, by virtue of not being specifically exempted, is shown in Table 1 (16).

**Private Projects.**—On January 16, 1977, a proclamation was issued to opera-

tionalize Section 3b of the act for private sector projects, and to allow specific designations of projects under the act. Since that time, four private sector projects have been specifically designated. A public participation program with respect to the more general implementation of the act for the private sector is scheduled to commence after the municipal regulations are in place.

**Municipal Projects.**—Since October, 1976, municipal projects have been temporarily exempted to allow the government to prepare regulations and to provide

**TABLE 1.—Sample List of Projects Requiring an Environmental Assessment**

Ministry (1)	Project (2)
Ministry of colleges and universities	New campuses for community colleges or universities
Ministry of the environment	New sewage treatment plants New water treatment plants New dump or landfill site
Ministry of government services	Capital construction—courthouses, airports, administrative offices, etc.—greater than \$1,000,000
Ontario Hydro	Transmission lines New transformer, distribution and switching stations operating at 115 kV or more New generating stations Communication towers Watershed diversions
Ministry of industry and tourism	Development of attractions and destination resorts Development of industrial lands
Ministry of natural resources	Forest management Dams, dykes, fishways Land reclamation Dredging Access roads
Ministry of transportation and communication	New routes Major realignments By-passes Highway widenings New commuter rail lines New commuter bus stations New expanded bus routes not on public roads Extended or expanded rail lines Overhead lines and buried cables

discussions on phasing in requirements. A regulation bringing municipalities under the act is imminent.

#### **ENVIRONMENTAL ASSESSMENT AS PLANNING PROCESS**

Environmental assessment refers to the planning process in which the conse-

quences of the project and alternatives are assessed, and to the actual report which documents that process.

The environmental planning process, shown in Fig. 1, has been devised by the ministry to assist proponents in the selection of a preferred project alternative (4). The objective is for proponents to document the planning process in a report, where emphasis is placed on comprehensive, rational planning to search, select, and justify a preferred project alternative.

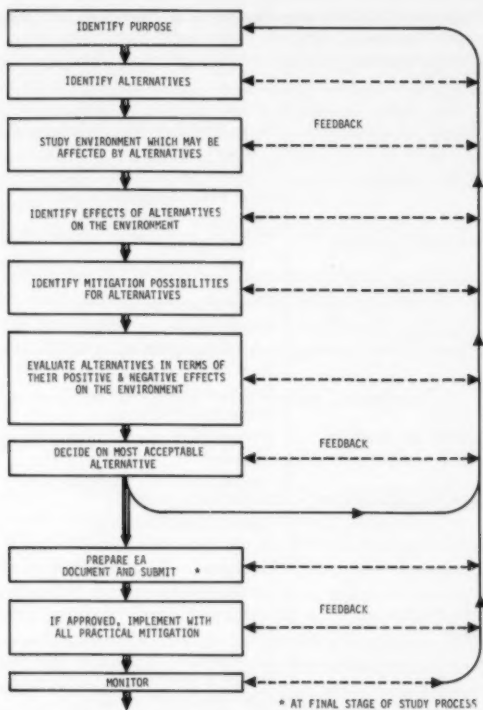


FIG. 1.—Environmental Planning Process

The implementation of this planning process offers a number of limitations (1):

1. The planning process, based on the scientific method, conveys a notion of objectivity and comprehensiveness which is inappropriate when social, economic, and political considerations are taken into account.

2. The planning process ignores the difficulty of searching for and identifying values, goals, and objectives for problem solving.

3. The planning process ignores the difficulty in searching for reasonable alternatives, and the complexity in identifying, predicting, and evaluating consequences resulting from project activities.

4. The planning process ignores the problem of evaluating a large amount of quantitative and qualitative information.

5. The planning process ignores the complexity of decision-making involving many actors.

6. The planning process offers no guide for structuring an iterative process.

Despite these limitations, the planning process, if conscientiously applied and rigorously described, offers potential by pin-pointing differences in opinions, concerns, and issues, thereby providing the basis for evaluation and selection among project alternatives. There is no guarantee that the selection of a preferred alternative will lead to issue resolution. Although opportunities are theoretically available for early issue resolution, efficiency and economy will be primary factors determining when the planning process will terminate. If any important issues remain unresolved, government EA reviewers, or the public, may recommend an Environmental Assessment Board hearing.

#### ENVIRONMENTAL ASSESSMENT DOCUMENT: CONTENT REQUIREMENTS

The Environmental Assessment document serves as the mechanism for describing the environmental planning process, and the medium for reaching a decision on project implementation.

If a project is subject to the EAA, the proponent is encouraged to contact the ministry to discuss informally the requisite items to be included in the EA, although this step is not a legal requirement under the act. The ministry will assist the proponent in developing an acceptable study design for the EA and preparing, on request, project-specific guidelines to assist in identifying the information requirements of the EAA.

The ministry has taken the position not to recommend any of the available environmental assessment methods found in the literature. Instead, the proponent is advised to select a method based on the special nature of the proposed project, and his internal way of doing business.

Following the consultative stage, the proponent, or consultant engaged by the proponent, prepares the EA to conform to the content requirements in the EAA and any project-specific guidelines.

The content requirements for an environmental assessment are found in Section 5(3) of the EAA:

1. A description of the purpose of the undertaking.
2. A description of and a statement of the rationale for the undertaking, the alternative methods of carrying out the undertaking, and the alternatives to the undertaking.
3. A description of the environment that will be affected or that might reasonably be expected to be affected, directly or indirectly, the effects that will be caused or that might reasonably be expected to be caused to the environment, and the actions necessary to prevent, change, mitigate, or remedy the effects upon the environment by the undertaking, the alternative methods

of carrying out the undertaking, and the alternatives to the undertaking.

4. An evaluation of the advantages and disadvantages to the environment of the undertaking, the alternative methods of carrying out the undertaking, and the alternatives to the undertaking.

#### TYPES OF ENVIRONMENTAL ASSESSMENTS

**Specific EA's.**—The majority of environmental assessments will be prepared for specific undertakings. A specific project is identified by timing activities and by location. About 50 environmental assessments for specific undertakings are under review. About 12 approvals have been given.

**Class EA's.**—A Class EA is "an environmental assessment carried out on a category of projects having certain special characteristics" (16).

Class EA's are generally prepared for similar projects, "relatively small in scale, having a high frequency of occurrence, and having predictable effects" (e.g., highway widenings, canoe routes) (16).

A Class EA must fulfill the content requirements outlined in Section 5(3) of the EAA. Compared with the specific EA, a class EA: (1) Characterizes a broad range of environmental effects; (2) describes a process by which each project within the class will be planned and implemented; and (3) is circulated to a larger number of government agencies for review.

Class environmental assessments are currently being prepared for different types of project classes, and are being submitted to the ministry for review and approval. A project, conforming to the terms and conditions described in an approved class environmental assessment, may proceed to be planned and constructed without the requirement of a formal review and approvals procedure. Since October, 1976 about 22 class EA's have been submitted to the MOE, and seven have been approved.

#### INTERPRETATIVE PROBLEMS IN SECTION 5(3) OF EAA

The EA content requirements in Section 5(3) of the EAA resemble those in Section 102(2)(c) of the U.S. National Environmental Policy Act (NEPA) (14). From 1970 to December, 1977, 938 NEPA cases were filed, with 31% of the cases being based on claims that Environmental Impact Statements were inadequately prepared (2). Section 5(3) of the EAA poses a number of interpretative problems which, if unclarified, could result in claims of EA inadequacy and requests for hearings. Emond suggests that American jurisprudence may assist in clarifying similar words and phrases found in Sections 5(3) of the EAA and 102(2)(c) of NEPA (3). For illustrative purposes, a few U.S. court decisions involving NEPA will be referred to. To date, no Ontario EA's have been heard under the hearing process established in the EAA. It is emphasized, however, that an EA is not an EIS. Whereas the emphasis in the EA is toward an integrated approach to planning and decision-making, the approach in preparing an EIS has generally been to fulfill an administrative requirement, although there are recent U.S. Council of Environment Quality regulations which attempt to promote the EIS as a planning instrument (2).

**Description of Purpose of Undertaking.**—The first interpretative problem lies in describing the purpose of the undertaking. It is insufficient for the proponent

to argue that the purpose of an undertaking is to satisfy a societal need such as shelter, food, recreation, etc. Instead, this section of the EA should define and clarify the problem(s), as perceived by the proponent. In addition, specific goals and objectives should be identified, leading to problem resolution. The preferred alternative which best achieves the proponent's goals and objectives, while resulting in an optimal balance of advantages and disadvantages to the environment, is described as the undertaking.

**Description of Rationale for Undertaking, Alternative Methods and Alternatives.**—This section logically explicates the rationale for selecting the preferred alternative. It is expected that the proponent declare the reasoning and justification for proceeding with the undertaking, on the basis of maximizing his goals and objectives. However, it is likely a situation may arise where the proponent's preferred alternative may not be the most desirable or acceptable in achieving the goals of other legitimate interests. The identification of goals, concerns, opinions, and preferences of other interests is not an explicit nor legal requirement under the EAA. Therefore, the gambling proponent may decide to ignore information which will not support his argument for the project, the strategy being to force adversaries into a hearing, if required, where the merit of the project will be debated.

In an EA, it is intended that the proponent argue in favor of a preferred course of action based on evaluating specific project alternatives and environmental effects. However, with the wording and comprehensive nature of the act, it is possible that the proponent could argue in favor of the preferred course of action, i.e., the undertaking, by aggregating the benefits of considerations such as land use, economics, servicing, design considerations, and municipal and provincial policies, and, in an attempt to devalue particular environmentally preferred project alternatives and enhance economically preferred others, evaluating them against the presentation of the natural environment.

One possible problem arises in relation to the proponent's responsibility in searching for and evaluating "alternatives to the undertaking," e.g., different technologies, all suitable alternative land uses for a development site, and "alternative methods of carrying out the undertaking," e.g., different site locations, physical layouts, dimensions, and construction methods. A second problem arises in regard to the degree of detail required to adequately describe and evaluate alternatives and alternative methods. Finally, it is suggested that for particular projects, a description and rationale for alternative methods for carrying out the alternatives may contribute useful information to be used on a comparative basis for decision-making. This consideration has been omitted from the act.

To avoid these problems, the EA should be viewed as a full disclosure document. This implies that the rationale should include ingredients of scientific evidence, objectivity, and good faith. It follows that if the EA is conceived as a full disclosure document, then a presentation of a range of all feasible alternatives provides the basis for an informed decision.

In commenting on this issue in *EDF versus Corps of Engineers*, the court ruled that structural and nonstructural alternatives should be adequately identified (5). The Ontario Ministry of the Environment also suggests that structural and, where appropriate, nonstructural alternatives should be identified. In addition, the do-nothing alternative should be described. The delineation of the range

of alternatives was decided on in NRDC versus Morton (8). The court concluded that "the requirement as to alternatives is subject to a consideration of reasonableness." The court further stated that the project alternatives beyond the agencies' jurisdiction to implement should also be examined. The Ministry of the Environment agrees.

The rule of reason has been applied in a number of court decisions. In the Cape Henry Bird Club versus Laird case, the court ruled that large studies on low priority alternatives is not a function of NEPA (9). In Sierra Club versus Froehike, the court ruled that the search for appropriate alternatives need be neither exhaustive nor speculative (10). In Brooks versus Coleman, the court stated that an EIS need not be vulnerable because it "fails to consider in detail each and every conceivable variation of the alternatives stated" (7).

The ministry has also stated that a "reasonable approach" should be adopted in identifying alternatives to accomplish the intended purpose, but has not formulated guidelines to determine a "rule of reason" (4).

**Description of Environment.**—A strength or weakness, depending on the side of the argument, is the broad scope of the environment to be assessed. The environment that may be affected is thusly defined in the act:

1. Air, land, or water.
2. Plant and animal life, including man.
3. Social, economic, and cultural conditions that influence the life of man or a community.
4. Any building, structure, machine, or other device or thing made by man.
5. Any solid, liquid, gas, odor, heat, sound, vibration, or radiation resulting directly or indirectly from the activities of man.
6. Any part or combination of the foregoing and the interrelationships between any two or more of them.

This broad definition has implications for defining the study area affected by the project. For example, water is defined in the act as "surface water and ground water." If the water environment is affected by a number of project activities, the proponent will be confronted with determining the extent of contamination, not only in surface water, but also in ground water. Thus, the study area, in assessing the concomitant environmental effects, may be large. It is possible that the proponent, in demonstrating good faith, may have to resort to sophisticated modelling techniques, thereby increasing the time requirements and costs of the environment assessment.

The description of the environment calls for an inventory of biophysical, socio-economic, historical, and esthetic resources and, where applicable, the dynamic processes within and among resources. The list of variables characterizing the environment and the methods available to collect data is extensive. The interrelationships among the environmental variables are not fully understood. The proponent is confronted with identifying significant environmental components and processes. However, parameters for testing significance have not been developed by the ministry.

This problem necessitates the proponent's consulting with the ministry before the EA process commences to determine the scope of the environment and to develop a cost-effective work plan for data collection, analysis, and evaluation.

**Description of Environmental Effects.**—The first application of a rule of reason in the EAA is found in the assessment of environmental effects. The act distinguishes between direct and indirect effects. It is implied that both types of effects should be treated equally. Direct effects are interpreted as being "the immediate physical effects and direct alterations to the environment of the undertaking itself" (4). Indirect effects are interpreted as being effects "induced" or "stimulated by the undertaking, or by the other alternatives being examined" (4). To an analyst, these definitions are ambiguous when read with Sections 5(3)(c)(ii) in the EAA and 102(2)(c)(i), (ii) in NEPA.

An interpretative problem lies in clarifying the notion of an environmental effect (the definition has been omitted in the EAA), and distinguishing between an effect and an impact. Although the term impact is not referred to in the EAA, a cursory examination of a number of EA's and EIS's reveals that the terms effects and impacts are used indiscriminantly.

An environmental effect is the reaction by receptors, specified in time and place, as a result of a project action. In theory, an effect is measured as the change in state (magnitude) of a receptor with and without the project action. The evaluation, based on a values set, the environmental effect, with emphasis on subjective evaluation, in terms of an effect being adverse or beneficial, is the degree of environmental impact. Although effects and impacts have been defined as synonymous in recent NEPA regulations, it is argued that references to impacts should be reserved for the effects evaluation stage.

Effect identification, measurement, and prediction involve an understanding of the dynamics of the project action, the receptors acted on, and the reaction by the receptors. To assist in characterizing an environmental effect, there are a number of important considerations to be assessed in the description of direct (primary) or indirect (secondary, tertiary, etc.) effects:

1. Identify quantitative or qualitative measures to describe the state (magnitude) of the effect on receptors.
2. Determine the relative significance of effects based on scientific evidence, values, and preferences.
3. Account for the dynamics and uncertainty of effects in determining relative significance by answering the following questions: When will the effect occur? How long will the effect last? How will the effect change over time? Where will the effect take place? What is the distribution of effects? Who will be affected?
4. Account for the incidence of the effect in determining relative significance.

Thus, the proponent is confronted with a major task in describing environmental effects resulting from activities of the undertaking, alternative methods to the undertaking, the alternatives to the undertaking, and alternative methods to the alternatives.

The only guideline for the proponent found in the act is that a notion of reasonableness may be applied to the description of environmental effects. In addition, it is implied that effects that are unexpected or unknown may not have to be included in the EA. A proponent then, who claims *in good faith* to have assessed environmental effects, both known and expected, may be exonerated from displaying *bad faith* if a number of significant environmental

effects are identified as being omitted during the review of the EA.

A second area of concern involves the existing state-of-the-art of environmental assessment methods. For the biophysical, economic, historic, and esthetic environments, the environmental effects resulting from the activities of a project can, to a large extent, be reasonably documented. For the social environment, effects on characteristics such as community cohesion, community sociability, and neighborhood contentment may be more difficult to assess. The real problem lies in the disparity in the various approaches to the development of methods to assess biophysical and social effects.

Finally, neither the act nor the ministry has indicated how conclusions pertaining to the environmental effects should be documented. A precedent case is found in *Ely versus Velde*. The Fourth Circuit Court of Appeals indicated that all relevant data must be summarized and presented to the decision-maker. The Court further stated:

To enable a court to ascertain whether there has been genuine, not a perfunctory, compliance with NEPA, the (agency) will be required to explicate fully its course of inquiry, its analysis and its reasoning (6).

**Description of Mitigating Measures.**—The proponent is obligated to identify mitigating (including remedial, compensatory, and preventative) measures in order to reduce adverse effects on the environment. The ministry suggests that any adverse effects resulting from the implementation of mitigating measures should also be identified. The act encourages the proponent to apply reasonableness in identifying mitigating measures, and concomitant environmental effects.

Monitoring the post activities of an undertaking to determine whether the mitigating measures are being implemented and are effective should be considered an integral part of environmental assessment. Although the environmental planning process suggested by the Ministry, shown in Fig. 1, identifies monitoring as an activity to be carried out after an undertaking is implemented, there are a number of important issues which require clarification:

1. Which projects should be monitored?
2. How will monitoring be carried out?
3. Who will underwrite the costs, and undertake the monitoring activity?
4. Who will evaluate the data with existing standards?
5. Will existing regulations be enforced if mitigation measures are ineffective?
6. How will the data from monitoring be utilized for other projects?

It remains a discretionary power for the ministry to specify whether monitoring will be a requirement to be included in an EA.

**Description of Evaluation of Undertaking and Alternatives.**—The basis for informed decision-making is determined from the evaluation process. The act indicates that the process involves making trade-offs among alternatives based on evaluating effects on the environment. At this juncture in the environmental planning process, the proponent should employ appropriate rational and heuristic processes as the basis for the evaluation. The proponent should describe the process rigorously, clarifying the issues of choice leading to and influencing the selected course of action, and indicate which issues, if any, remain unresolved.

There may be a difference in opinion regarding the advantages and disadvantages of the project to the environment. In EDF versus Corps of Engineers, the court ruled that opinions from qualified professionals which differ from the proponent must be included in the environmental assessment (5). It was concluded that the inclusion of conflicting statements would reduce the contention that the proponent intentionally deleted substantive findings.

### EA AND PROJECT APPROVALS

The EA and project approvals process specified by the government is shown in Fig. 2 (16).

A proponent may consult with government ministries and the public in preparing the EA. At an appropriate time during the preparation of an EA, a proponent may voluntarily submit a draft EA to a ministry staff member or other interested agencies for preliminary informal review and comments. There is no government circulation of the EA during this presubmission stage. The objective of the informal review is to assess the content, organization, and logic of the EA, and whether the proponent is on track or not.

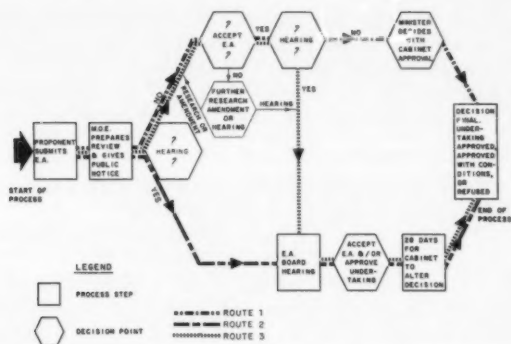


FIG. 2.—Basic Flow Diagram of Environmental Assessment Act, 1975

The proponent decides on the content and wording in the final EA. It is possible for the proponent to disagree with, revise, and delete content and wording written by a consultant, or recommended during the consultative stage.

When completed, an EA is formally submitted to the Minister of the Environment for review by the government. The purpose of the review is to make recommendations on the completeness and accuracy of the document. Government ministries, with an interest in the undertaking and its implications, will review the EA and forward comments and recommendations to the ministry. The method of circulating the EA to other ministries in the provincial government is not discretionary. A list has been drawn up of EA contact people in other ministries who have indicated which types of EA's their ministry is interested in reviewing. Based on this, The Ministry of the Environment circulates particular EA's to those ministries which indicated they wish to review the particular

EA, or similar EA's. The ministry, acting as coordinator, will seek to resolve conflicts where they arise among the ministerial positions. Sometimes the conflicts will be left standing and sorted out at a hearing.

After completion of the EA review, the minister is required to serve public notice that the environmental assessment and the review are available for inspection at designated locations. The EAA provides for public advertising when it is impractical to give either the notice or the EA to all interested individuals. Notice would indicate where information is available.

The government review is not a final decision on the document or on the project itself. Rather, it represents a staff recommendation to the minister. The minister releases the review to receive input from the public and proponent on statements made in the EA and the review. Within 30 days of serving notice, or for a longer period, if specified, any person may inspect the environmental assessment and the review.

The act provides that any person may make written submissions to the minister regarding: (1) The undertaking; (2) the EA; and (3) the review. In addition, the act states that any person may, by written notice to the minister, require a hearing by The Environmental Assessment Board (a quasijudicial proceeding) with respect to these matters.

If the proponent identifies that there is sufficient negative feeling about the EA, he may, on approval of the minister, withdraw it from the formal review process, revise it, and resubmit the EA to the ministry.

After the expiration of the review period and the consideration of any submissions, there are three possible outcomes involving both the EA and the project:

1. Case I.—The minister makes decisions about both the EA and the undertaking. The second decision is subject to cabinet approval.
2. Case II.—The Environmental Assessment Board makes both decisions about the EA and the undertaking, subject to cabinet review.
3. Case III.—The minister and the board may both be involved in making decisions about the EA and the undertaking, subject to cabinet review, or the minister makes a decision on the EA and the board makes a decision on the undertaking, subject to cabinet review.

**Case I (Route 1 in Fig. 2).**—In this case, a hearing before the Environmental Assessment Board is not required. The minister evaluates the EA document based on the government review and any submissions received, and, if it is determined that the EA satisfies the content requirements of the act, then the EA is accepted. Alternatively, the minister may require further research, investigations, studies, or monitoring, or may amend the EA to a more acceptable form, e.g., suggesting specific conditions of approval. Notice of these decisions is given to the proponent and other interested parties. When the EA is satisfactorily revised, the minister accepts it.

Notice of acceptance is given to the proponent and persons who made written submissions earlier in the review process. Within 15 days of receiving the notice, the proponent or other party, by written submission, may require a public hearing to decide whether or not the project as proposed should be approved.

If no hearing is required, the minister, with the approval of the cabinet,

decides: (1) To approve the project unconditionally; (2) to approve the project subject to terms and conditions specified by the Minister; or (3) to refuse to give approval to the project. The involvement of the cabinet implies that the decision to proceed or not proceed with a project involves trade-offs between legitimate but sometimes conflicting government objectives. The cabinet determines whether the environment has been given due weight. Notice of the decision is given to the proponent, to those who made submissions, and to other persons the minister advises should receive the notice. The decision is final.

**Case II (Route 2 in Fig. 2).**—If the minister receives a written submission from the proponent or other person requiring a hearing, or if she or he decides it is advisable, then a hearing will be held unless the minister considers that the request is frivolous or vexatious or that a hearing is unnecessary or may cause undue delay.

If the minister advises that a hearing should be held, then notice is given to the Environmental Assessment Board who then decides on the acceptance or amendment of the EA and the approval of the project. The board notifies the proponent, the public, any person who has made a written submission, or any other persons recommended by the minister, of the time for the hearing.

After hearing the evidence introduced by the parties involved, the board reaches a decision on the acceptance of the EA and the approval of the project. For a period of 28 days, or a longer period of time as determined by the Minister, he, with Cabinet approval: (1) May vary the board's decision; (2) may substitute an appropriate decision; or (3) may require the Board to hold a new hearing. However, after the expiration date, the board's decision, or the substituted decision, is final. The minister notifies all relevant parties of the decision.

**Case II (Routes 3a and b in Fig. 2).**—If no hearing is required at the first opportunity in the review process, the minister decides on the acceptability of the EA. If the minister considers the EA to be unsatisfactory, then the minister can order further research or amend the EA to make it satisfactory. The notice of proposed amendments triggers an opportunity for a public hearing. Alternatively, the minister may require a hearing on his or her own initiative, or at the request of the proponent. If a decision is made to hold a hearing, the board proceeds with the matter as outlined in Case II. Notice of acceptance is granted by the minister.

If the minister considers the EA to be satisfactory, the notice of this decision is sent to the proponent and to those persons who made written submission. No hearing is required.

Within 15 days of receiving the notice, the proponent or any other party may request a hearing on whether or not the project should be approved. The minister then decides whether a hearing is warranted, based on the comments expressed in the submissions or on ministerial initiatives.

If a hearing is required, the board decides whether the project should be approved with or without conditions, or should be denied approval (Route 3b). The decision is referred to the Cabinet for their consideration, as described in Case II.

#### **FUTURE DIRECTION OF ENVIRONMENTAL ASSESSMENT IN ONTARIO**

In 1980, it is expected that a regulation operationalizing the EAA for municipal

projects will be applied to all Ontario municipalities. This regulation will ensure that environmentally significant municipal projects will be planned and implemented to correspond with provincial environmental policy; it is not intended to usurp municipal responsibility in planning local projects. The regulation will exempt municipal projects where the total estimated costs are less than \$2,000,000, specifying types of projects that are subject to the EAA, whatever their cost, specify short-term exemptions to allow phasing in of environmental assessment requirements for projects that are in an advanced stage of planning, and exempt a number of projects on a permanent basis. In addition, the regulation will specify certain types of projects and allow municipalities time to adapt class assessments which are being prepared by provincial agencies. Table 2 indicates the types of municipal projects likely to be subject to the act, exclusive of their cost, under the EAA (18).

TABLE 2.—Municipal Projects Subject to the Environmental Assessment Act (EAA)

Projects scheduled for subsection (and when EAA applies), if available (1)	Projects likely to be subjected <sup>a</sup> (2)
All new roads and road re-alignments (1979) <sup>b</sup> Construction of dams and reservoirs (1980) Channelization, stabilization, or diversion of watercourses (1981) Construction of dykes and levees (1982) Dam reconstruction (1984) Wildlife, including fish habitat manipulation (1985) Waste disposal sites (1979) <sup>b</sup> New sewerage and water works and distribu- tion facilities New rail and transit systems, new bus routes on exclusive ROW's, etc.	Small transmission lines, transformer stations, and switching stations Widening of existing highways Adjustments to alignment, grades, or cross-section New interchanges New or modified water crossings Freeway upgrading Highway service facilities Process changes, plant expansions
<sup>a</sup> Expected to be under EAA 12 months after provincial approval.	
<sup>b</sup> With some minor exceptions.	

The previously discussed environmental assessment and project approvals procedure will also apply to municipal project. It is intended that the ministry will coordinate the government review of a municipal projects EA to ensure an array of opinions from various interested ministries and other parties. If a board hearing is required, then there will be an opportunity for municipal and public input.

Of major concern in municipalities is the potential for conflict and duplication between the application, review, and hearing procedures for projects subject to both The Environmental Assessment Act and a new Planning Act (12). Since 1974, the ministry has made a concerted effort to address this concern by establishing two principles to rationalize the administration of the two acts (17):

A new Ontario Planning Act will administer environmental factors as an integral part of municipal planning. A new Planning Act will indicate that environmental factors will be given the same weight as other factors in municipal planning.

The responsibilities of other provincial ministries, in reviewing how natural environment and socio-economic factors have been considered in municipal planning, will be accomplished by administrative arrangements rather than specific legislative requirements. For the private sector, the EAA will continue to only apply to projects of provincial or major interest. Hence, the large majority of routine private projects (subdivisions, apartment buildings, and shopping centers) will not be subject to the EAA, but will remain subject to the new Planning Act.

Where duplication, conflicts, or overlap appears between the EAA and another Act, an integrated solution will be developed. As indicated, private projects of major significance, i.e., oil refineries, pulp mills, etc. are likely to be designed under the EAA. These projects may also be subject to The Planning Act. The new Planning Act specifies that the EA and project approvals process will be employed as the decision-making process, in which all matters relevant to both acts will be considered, integrated, and streamlined.

This integrated approach will also be employed for a public project subject to the EAA and other Acts. For example, if a waste disposal site is subject to the EAA, a waiver of a public hearing under the Environmental Protection Act will be ordered to avoid duplicate hearings. If approvals are also required under The Planning Act, the EA and project approvals process will be employed to integrate and streamline all matters relevant to both acts. In the near future, an omnibus bill will streamline The Planning Act, some regional municipality acts, and other relevant acts with the EAA.

There is another future prospect for environmental assessment: The adoption of environmental assessment as an urban or regional planning policy. A number of municipalities have incorporated or are incorporating into their official plans environmental assessment as a policy to evaluate the environmental effects of designated public and private projects. However, these municipal environmental assessment processes are different in procedure from the provincial environmental assessment process.

## CONCLUSIONS

Environmental assessment as an anticipatory, comprehensive planning process may not fully be achieved. The intent of the EAA, to document the environmental planning process as the basis for decision-making, should be applauded. However, because the emphasis in an EA is for a proponent to identify and resolve a problem on the basis of logical argumentation, notions of comprehensiveness and objectivity may not be fully realized.

This planning process has been shown to be limited in application. An indication is found in a recent U.S. study, the purpose of which was to test the level of integration of environmental assessment in public sector planning (13). One study finding revealed that there is, generally, a preconceived concept of the project and that alternatives are formulated primarily to satisfy various planning requirements. It was also found that the planning process, shown in Fig. 1, was not being applied in practice, in that the formulation of alternatives and selection of the preferred alternative were similar to the preconceived project concept. Hence, the underlying premise of comprehensiveness and objectivity sought after in the Green Paper may not be fully realized (15).

The environmental planning process, suggested by the Ontario Ministry of the Environment, will be modified to fit the social and political realities of decision-making. The environmental planning process suggested by the ministry is one process by which to reach a decision. There are, however, a multiplicity of decisions and a variety of decision-making environments because of the comprehensive approach to planning and wide scope of environmental assessment. Therefore, a variety of planning processes ranging from rational processes, where the emphasis is on efficiency and solution, to heuristic processes, where the emphasis is on the satisfactory resolution of an issue or problem, should be explored. The social and political realities of the planning and decision-making environment should be understood first before the planning process is selected. Any attempt to impose a uniform planning process will be balked at by proponents. Economy and efficiency will probably determine the planning process utilized by the proponent.

3. The Ministry of the Environment will find that an environmental assessment and the EAA will be difficult to administrate and coordinate. Difficulties lie in: (1) The broad interpretation of the environment; (2) the number of interpretative problems in Section 5(3) of the EAA; (3) the absence of specific information giving direction to what constitutes an adequate EA; (4) the absence of specific procedural requirements for participation and conduct in an EAB hearing under the EAA; and (5) the unpreparedness of municipalities to implement EA.

The ministry should reassess the desirability and economy of retaining the wide scope of the environment to be assessed. In addition, the ministry is urged to develop specific guidelines to assist in the preparation and review of an EA and participation in an EAB hearing. The ministry should coordinate workshops with local planning departments to discuss the implementation of EA in municipal planning and its implications.

Proponents will press the ministry for EA information: exemptions, EA preparatory and procedural matters, and other items. The public and review agencies will also make demands on the ministry. With the current staffing level and work load, the ministry will be hard-pressed to effectively meet all requests and efficaciously coordinate and administrate the EAA with minimal delay in project implementation.

4. Environmental assessment, as a preventative, comprehensive, coordinated, and integrated approach to project planning, should assist in improving the quality of Ontario's environment. Environmental assessment injected early into comprehensive project planning, integrating current pollution abatement measures—technical, legal, and policy-oriented—and coordinated with the concerns of other cooperative interests, should assist in working toward the goals sought for Ontario's environment.

Future research should examine the cost-effectiveness of environmental assessment in achieving environmental and development goals. To this end the post-evaluation of environmental effects resulting from project activities should be compared with those anticipated in an EA.

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Environmental Planner, Environmental Assessment Section, Environmental Approvals Branch, the Ministry of the Environment, Ontario.

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## FUNCTIONAL PLANNING TOOL: TOURISM IMPACT MODEL

By Richard G. Fritz,<sup>1</sup> A. M. ASCE, and Mike Konecny<sup>2</sup>

### INTRODUCTION

The purpose of this paper is to examine an economic modeling technique which considers the existing relationship between tourism expenditures and various economic impacts that result from them. Specifically, it is a system of average impact multiplier linkages relating tourism expenditures to economic consequences. This model is designed to represent a regional economy, although aggregation to a national system is theoretically possible. It is the product of a long line of "impact" models, from Isard (1), to Miernyk (4), to Richardson (6). Recently, the value of "econometric" regional models has been argued by Klein and Glickman (3). The influences of these theoretical foundations have been incorporated into this Tourism Impact Model (TIM).

The term "economic impact" refers here to employment, government revenues, and income generated by tourism expenditures. Also, the model considers the intermediate impact of capital investment induced by tourism expenditures. The impacts are estimated for three tourism-related sectors, which are the immediate recipients of tourist dollars:

1. Sector I.—Commercial accommodation, meals, and beverages.
2. Sector II.—Transportation: Subdivided by mode of transport.
3. Sector II.—Recreation, entertainment, and other related purchases.

In the following methodology section, two types of impact estimating procedures are used. First is an econometric analysis in which investment is estimated from a series of explanatory variables. The linkages calculated by the regression technique are the average historical behavioral parameters. The other technique requires the input-output model for the relevant region for which the system is used. The I-O model links average output of one industry or one commodity to the average inputs used by the industry or used in the production of the commodity. The total production inputs estimated by the input-output model

<sup>1</sup>Asst. Prof. of Economics, Univ. of Central Florida, Orlando, Fla.

<sup>2</sup>Chf. Economist, Bureau of Management Consulting, Ottawa, Ont., Canada.

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can be transformed into or are themselves the economic impacts under consideration. Thus, the economic impact parameters or "multipliers" are the links between current tourism expenditures and current economic impacts.

The final section will present an example of the model using the Canadian province of Nova Scotia. Several other prototypes have been completed, including the "Canadian TIM," which quantifies national impacts (5,7).

## METHODOLOGY

The system separates the various economic impacts from tourism into compartments: (1) The results from tourism-related sectors satisfying the current demand for goods and services; and (2) the results from current capital feedback induced by past expenditures in tourism-related sectors. The assumption is the current investment in these related sectors is a function of past profits. In general, the TIM investment equations estimate current investment as a function of

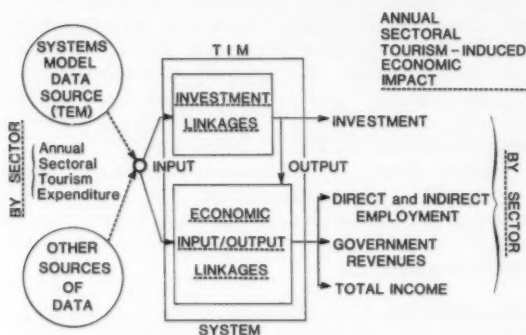


FIG. 1.—Tourism Impact System

lagged sales, interest, and an autonomous term that reflects the overall level of investment activity as a result of the cyclical variations in the regional economy. Sales is the dominant variable, both theoretically and empirically in the investment functions.

The methodology of the system is illustrated in Fig. 1. For each tourism-related sector, the TIM receives as input the expenditures attributable to tourists. First, the investment linkages are calculated. Then the calculated induced investments are inputted, along with the current sectoral expenditures, into the input-output portion of the TIM so that the total current economic impacts are determined. The investment in each sector, in dollar terms, is a direct output since it is a type of "impact" that analysts of the tourism industry frequently wish to examine.

The economic impact linkages are derived from iterations of the I-O model. The total impact is the sum of the direct impact within the tourism-related sectors and the impacts in all the other industries which supply the intermediate goods and services to the industries satisfying the tourism final demand.

Accordingly, the size of the multipliers depends on two factors:

1. The regional multiplier effects are a function of the proportion of the intermediate goods and services that are supplied from the region itself in order to sustain final consumption in the regional tourism-related sectors. As that proportion increases or as the region becomes more self-sufficient in terms of providing all the intermediate tourism commodities, there is less "leakage" of the tourism dollar from the region; thus the impact multipliers are relatively larger.

2. The size of the multipliers depends on how many iterations of the relevant I-O model were made before the process was terminated. The impact coefficients used in this system are closed multipliers. That is, they take into account the impacts of all relevant responding originating from the tourism expenditure.

#### UNDERLYING ECONOMIC THEORY

In operational terms, the model calculates total sectoral investments, then takes a proportion of that total and defines it as the "tourism-induced investment." This investment then becomes an input added to the current tourism expenditures accounted for in the impact equations. We assume that investment in the subsequent time period,  $I_{t+1}$ , is a linear function of profit in the sector in the current time period,  $\Pi_t$ , and an "accelerator" in the current period,  $(I_t - I_{t-1})/I_{t-1}$ :

$$I_{t+1} = \nu_t \Pi_t + \gamma_t \left( \frac{I_t - I_{t-1}}{I_{t-1}} \right) \quad \text{when } \nu_t > 0; \gamma_t \geq 0. \quad (1)$$

For the sake of simplicity in the general economic theory, no sectoral distinction is made among the variables. The investment theory is the same for all sectors. The length of the pertinent time period is empirically defined. Only the concept of a time lag is necessary in order to understand the economic theory underlying the investment functions. For a comparison of econometric studies of investment behavior, the reader is referred to Jorgenson (2).

The decision to invest is made at time,  $t$ , based on the profitability of the sector at that time and the cyclical sectoral investment activity taking place at time,  $t$ . The investment takes one time period to materialize after the investment decision is made. The accelerator term represents the cyclical state of the sectoral economy. By being expressed as a rate of change, the accelerator term reflects the conventional macroeconomic conclusion that the current absolute level of investment expenditures is a function of the rate of change in such expenditures in the previous time period.

Current sectoral sales,  $S_t$ , is defined to be the price of the sectoral product,  $p_t$ , times the number of units of the product,  $Q_t$ :

$$S_t = p_t Q_t \quad (2)$$

The cost of current production,  $H_t$ , is the sum of the variable costs plus the capital costs which are fixed at each time period. The variable costs,  $\tau_t L_t$ , are assumed to be proportional to the labor input,  $L_t$ ; the imputed capital cost,  $r_t K_t$ , is the current interest rate,  $r_t$ , times the current stock of capital,  $K_t$ .

Thus, the cost of production is

$$H_t = \tau_t L_t + r_t K_t; \text{ when } \tau_t, r_t > 0 \quad (3)$$

Finally, profit is defined as the sectoral sales minus the cost of production:

$$\Pi_t = S_t - H_t \quad (4a)$$

$$\text{or } \Pi_t = P_t Q_t - \tau_t L_t - r_t K_t \quad (4b)$$

Since capital at time  $t$  cannot be significantly altered until time  $t + 1$ , production at any given time period can be expressed as a time-dependent (an implicitly capital-dependent) function of the variable inputs alone. That is, within the time period during which capital expansion is not possible, production depends solely on the intensiveness of the utilization of the variable inputs. All variable inputs are assumed to be proportional to the labor input (this assumption underlies the definition of the variable costs as  $\tau_t L_t$ ). And, therefore, by employing a linear production function, production in any time period,  $t$ , is proportional to the labor input:

$$Q_t = \zeta_t L_t \quad (5)$$

Hence, by dividing and multiplying the first two terms of Eq. 4b by Eq. 5, the sectoral profit can be expressed

$$\Pi_t = \left( p_t - \frac{\tau_t}{\zeta_t} \right) Q_t - r_t K_t \quad (6)$$

Dividing and multiplying the first term of Eq. 6 by  $p_t$ , and substituting from Eq. 2, sectoral profit may be expressed

$$\Pi_t = \left( 1 - \frac{\tau_t}{\zeta_t p_t} \right) S_t - r_t K_t \quad (7)$$

Now, substituting Eq. 7 into Eq. 1 reveals that investment may be expressed

$$I_{t+1} = v_t \left( 1 - \frac{\tau_t}{\zeta_t p_t} \right) S_t - v_t K_t r_t + \gamma_t \left( \frac{I_t - I_{t-1}}{I_{t-1}} \right) \quad (8a)$$

$$\text{or } I_{t+1} = \alpha_t S_t - \beta_t r_t + \gamma_t \left( \frac{I_t - I_{t-1}}{I_{t-1}} \right) \quad (8b)$$

$$\text{in which } \alpha_t = v_t \left( 1 - \frac{\tau_t}{\zeta_t p_t} \right) \quad (9)$$

$$\text{and } \beta_t = v_t K_t \quad (10)$$

Hence, sectoral investment in the subsequent time period can be expressed as a function of the current sectoral sales, an accelerator term, and the interest rate.

Now, use of the regression technique to estimate  $\alpha_t$ ,  $\beta_t$ , and  $\gamma_t$  forces those coefficients to be constant for all time periods,  $t$ . The economic interpretation of this is not that  $\alpha_t$ ,  $\beta_t$ , and  $\gamma_t$  are actually time-invariant. For example,  $K_t$  can be expected to be generally increasing over time. Rather, the regression technique finds an average value for  $\alpha_t$  and  $\beta_t$  over the time period for which

the TIM investment functions are estimated. Thus, the estimated regression coefficients,  $\hat{\alpha}$ ,  $\hat{\beta}$ , and  $\hat{\gamma}$ , yield an average, time-invariant counterpart to Eq. 8b:

$$I_{t+1} = \hat{\alpha}S_t - \hat{\beta}r_t + \hat{\gamma}\left(\frac{I_t - I_{t-1}}{I_{t-1}}\right) \dots \dots \dots (11)$$

Consider now the problem of inflation. Because reliable monetary deflators do not presently exist at least for the sales in the tourism-related sectors, all the variables are expressed in current monetary terms rather than in constant dollars. Even so, the use of deflators in the present case does not in any way guarantee better stability of the econometrically estimated parameters.

Returning to Eq. 11, it is evident that the total investment in the tourism-related sectors is estimated partially as a function of total sales in the sector, not just the tourism portion of sales. This is due to the fact that investment involved expansion in a plant capacity that undistinguishably serves both tourists and nontourists. Moreover, because the investment is partially a function of profit, which is itself partially a function of the interest rate, the effects of sectoral sales and interest rate in inducing investment cannot be physically separated. Hence, it is not valid to estimate the portion of investment due to tourism expenditures merely by substituting the tourism expenditures for  $S_t$ . Rather, the investment equations must be used in conjunction with total sectoral sales such that total investment is estimated; then the tourism portion of the total sectoral investment,  $I_t^T$ , can be estimated in this way:

$$I_t^T = \left(\frac{E_t}{S_t}\right) I_t \dots \dots \dots (12a)$$

$$\text{or } I_t^T = \rho I_t \dots \dots \dots (12b)$$

in which  $\rho = (E_t/S_t)$ , when  $\rho \leq 1$ ; and  $E_t$  = the tourism expenditures in the sector. Accordingly,  $I^T$  is simply an accounting fiction. Investment cannot be physically split into tourism-induced investment and investment for local usage. All investment in the long run is assumed to be built to satisfy the total sectoral demand, and the capital requirements and usage are assumed to be identical for both local and tourist sectoral demands.

Finally, the general specification of the sectoral investment functions is that given by Eq. 11. All of the variables in that equation have a theoretical basis. However, the significance of the parameters,  $\hat{\alpha}$ ,  $\hat{\beta}$ , and  $\hat{\gamma}$ , associated with those variables, is an empirical matter. Accordingly, all three variables are not necessarily present in each sectoral investment equation if some parameters are found in a statistical sense to be insignificantly different from zero.

By estimating the economic impact by means of an input-output model, the TIM implicitly makes the following assumptions concerning the nature of the tourism industry and the nature of tourism expenditures. First of all, the estimated impacts are average effects. An input-output model combines all of the inputs used by firms comprising an industry or all the inputs used by firms producing a certain commodity (class), and by so doing determines the average input mix within an industry or the average input mix to produce some commodity output. An input-output model does not assess marginal impacts. Hence, when

the marginal impacts are different from the average ones, the TIM impact coefficients distort the economic consequences.

In addition, an input-output model, being linear, assumes that all production is technologically independent and exhibits constant returns to scale. This means that the mix of production inputs is not affected by the level of economic activity within the industry and that the levels of economic activity of other industries do not affect the technology or input mix of that industry either. Therefore, to whatever extent the technologies of production in the tourism-related industries are interdependent, the TIM impact coefficients become outdated as the level of production changes over time.

Finally, an input-output model assumes that the market shares of the firms in the pertinent economy remain constant. In other words, if several firms produce the same commodity, an input-output model normally assumes that future total production is allocated among the firms according to the distribution existing at the time the model was constructed. Likewise, if one firm produces several commodities, an input-output model normally assumes that the commodity mix of outputs remains the same. Hence, the TIM impact coefficients are not accurate if an expansion of tourism activity is known to change significantly the product mix of the relevant economy. Furthermore, the impact coefficients may not accurately estimate impact on one firm or one region if the tourism activity changes the market share of the firm or region.

#### DOCUMENTATION OF MODEL, NOVA SCOTIA

The model is divided into its two compartments. The first, concerning the investment functions, is estimated econometrically. The second utilizes the regional I-O model to solve for tourism-generated income, government revenue, and employment.

The composite tourism industry is divided into three aggregate sectors. The sectors are:

1. Sector 1.—Accommodations, meals, and beverages: This sector includes hotels, motels, motor inns, motor hotels, tourist homes, lodges, cabins, chalets, and camping grounds, along with souvenir shops and eating and drinking places inside these establishments. The sector also includes outside restaurants and drinking establishments.

2. Sector 2.—Transportation: This is composed of private automobile transportation. (Obviously other modes of transportation may be included in general. However, with Nova Scotia, rail, air, and motor coach were found to be insignificant and therefore not included.)

3. Sector 3.—Recreation, entertainment, and other: This covers recreation facilities such as theatres, arenas, marinas, parks, pools, tennis courts, and so forth.

The data for the Nova Scotia prototype were available in annual reports from Statistics Canada: "Construction in Canada," "Traveller Accommodation Statistics," and "Restaurant Statistics." The interest rate used for the investment functions was the chartered bank prime business lower rate, which is available in the "Bank of Canada Review."

The tourism-induced investment,  $I^T$ , is a fraction,  $\rho$ , of the investment,  $I$ , from Eq. 12b.  $\rho$  = the ratio of tourism sales to total sales in the sector. Tourism sales,  $S^T$ , are calculated from the Nova Scotian Tourism Expenditure Model (TEM) (7). The following are the estimated values of  $\rho$  of the three sectors:

1. Sector 1.—Accommodation, meals, and beverages: In Sector 1  $\rho = (1 + \chi\lambda)/(1 - \lambda)$ , in which  $\chi$  = the ratio between tourism restaurant sales and total restaurant sales; and  $\lambda$  = the ratio between total restaurant sales and total accommodation sales. The tourism restaurant sales and the total accommodation sales are from the Nova Scotian TEM outputs;  $\chi$  was calculated to be 0.5 and  $\lambda$  was calculated to be 1.25. Therefore,  $\rho = 0.72$  for Nova Scotian Sector 1.

2. Sector 2.—Private automobile transportation: Here  $\rho$  = the ratio between tourist expenditure on gasoline in 1974 and total gasoline sales in Nova Scotia for 1974. For the latter figure, gasoline sales in terms of gallons, obtained from Transport Canada, are converted into dollars by multiplying by \$0.66. This estimate was obtained from the Nova Scotia Department of Tourism, originally for use in the Transportation Sector of The Nova Scotian TEM. Tourism gasoline sales are calculated from the Nova Scotian TEM. Thus,  $\rho = 0.11$  for Nova Scotian Sector 2.

3. Sector 3.—Recreation, entertainment, and other: Since data on the total (tourism plus nontourism) expenditures in Sector 3 are presently unavailable, an illustrative value of  $\rho$  was assumed, based on the value of  $\chi$  in the calculation of  $\rho$  for Sector 1. The hypothesis is that dining out is a type of and a substitute for other kinds of entertainment activity. So  $\rho = 0.4$  for Nova Scotian Sector 3. Obviously, this hypothesis should be empirically tested.

The multipliers used in the Nova Scotian TIM are obtained from the provincialized national input-output model by Statistics Canada. Sector 1 multipliers were obtained by simulating the final demand for hotel and restaurants; Sector 2 from automobile operation, Sector 3 from travel and entertainment, and the capital sector from nonresidential construction. All impact multipliers are based on closed I-O runs, so total direct and indirect effects of all rounds of spending set off by the original tourism-related expenditure are captured. All impacts accruing elsewhere are regarded as leakages.

The following TIM prototype was estimated using annual data for 1960–1974. Figures in parentheses under econometric coefficients are students'  $t$  values for the coefficients. All variables, except  $N^T$ , are expressed in thousands of dollars;  $N^T$  is expressed in man-years.

**Nova Scotian TIM.**—Sector 1.—Accommodation, meals, and beverages:

$$I_t = 0.188 S_{t-1} - 667.775 r_{t-1} \quad \begin{array}{c} \overline{R^2} \\ 0.733 \end{array} \quad \begin{array}{c} \text{D.W.} \\ 1.898 \end{array} \quad \begin{array}{c} \text{S.E.E.} \\ 1,130.951 \end{array} \quad \begin{array}{c} \text{N.O.} \\ 11 \end{array} \quad \dots \quad (13a)$$

(5.132)                      (-2.604)

$$I_t^T = 0.72 I_t \quad \dots \quad (13b)$$

$$Y_t^T = 1.217 E_t + 0.976 I_t^T \quad \dots \quad (13c)$$

$$N_t^T = 0.183 \frac{1}{Z_{66}^1} E_t + 0.105 \frac{1}{Z_{66}^T} I_t^T \quad \dots \quad (13d)$$

$$G_t^T = 0.113 E_t + 0.071 I_t^T \quad (13e)$$

Sector 2.—Private automobile sector:

$$I_t = 1.391 S_{t-1} \frac{\bar{R}^2}{0.844} \frac{D.W.}{1.668} \frac{S.E.E.}{8,143.047} \frac{N.O.}{11} \quad (14a)$$

(25.312)

$$I_t^P = 0.088 S_{t-1} - 189.488 r_{t-1} - 18.198 C_{t-1}$$

(5.151)                      (-1.534)                      (-2.485)

$$+ 17.855 C_{t-1}^P \frac{\bar{R}^2}{0.815} \frac{D.W.}{2.638} \frac{S.E.E.}{502.881} \frac{N.O.}{11} \quad (14b)$$

(3.292)

$$I_t^T = 0.11 I_t \quad (14c)$$

$$Y_t^T = 0.864 E_t + 0.976 I_t^T \quad (14d)$$

$$N_t^T = 0.049 \frac{1}{Z_{66}^2} E_t + 0.105 \frac{1}{Z_{66}'} I_t^T \quad (14e)$$

$$G_t^T = 0.087 E_t + 0.071 I_t^T \quad (15e)$$

Sector 3.—Recreation, entertainment, and other:

$$I_t = 0.080 S_{t-1} - 289.374 r_{t-1} + 159.678 C_{t-1}^c$$

(3.295)                      (-1.751)                      (2.757)

$$+ 16.894 C_{t-1}^{c3} \frac{\bar{R}^2}{0.776} \frac{D.W.}{2.885} \frac{S.E.E.}{716.453} \frac{N.O.}{11} \quad (15a)$$

(2.355)

$$I_t^T = 0.4 I_t \quad (15b)$$

$$Y_t^T = 1.398 E_t + 0.976 I_t^T \quad (15c)$$

$$N_t^T = 1.30 \frac{1}{Z_{66}^3} E_t + 0.105 \frac{1}{Z_{66}'} I_t^T \quad (15d)$$

$$G_t^T = 0.087 E_t + 0.071 I_t^T \quad (15e)$$

#### SUGGESTED USES OF MODEL

Although several potential uses of the TIM are suggested subsequently, the list is not intended to be exhaustive; rather it provides the user with an indication of the analytical potential of the TIM. Additional uses may be realized once specific problems are presented to a TIM user who fully appreciates its structure. In the suggested applications of the model below, those uses listed as items 1-5 result primarily or entirely from the TIM input-output box of Fig. 1, while uses 6-11 are derived from the TIM investment box. The suggested uses generally become more sophisticated as the listing proceeds. The uses of the TIM are as follows:

1. The TIM may be used to determine whether or not the inputs necessary to accommodate a postulated or forecasted final demand in some tourism-related sector are available. This report has typically described the TIM as transforming a given tourism expenditure into a series of economic impacts irrespective of constraints which may exist on production. However, the importance of such constraints can also be examined; the TIM may be used to estimate a rather detailed list of inputs that would be required to satisfy a given final demand in each tourism sector so that the feasibility of such a postulated demand can be verified. This use requires an independent knowledge of the inputs available in the province or country so that the "impacts" estimated by the TIM can be checked against those availability constraints. If the constraints are violated, it means that the postulated or forecasted tourism development is not feasible. An associated usage of the TIM is to check the feasibility of the postulated tourism development so that the requisite inputs can be provided if they are presently unavailable or expected to be so.

2. Many of the uses of the TIM relate to interindustry comparisons. For example, the federal or provincial governments may want to judiciously influence the industrial development in their respective domains in accordance with their own policy decisions. In general, there will be limited resources available for such purposes, so that the governments will be faced with the problem of optimally allocating their scarce developmental resources. Since most developmental policy objectives consider at least some economic impacts like employment, investment, or income generated, in order to know the relative economic desirability of each, it is critical to understand the relative economic impacts of the various industries. The TIM can be used to provide estimates of the aforementioned economic impacts of the tourism industry. The impacts associated with whatever industry tourism is being compared with would have to be provided by another economic impact model corresponding to that other industry.

3. If a governmental policy that subsidized or taxed some of the tourism-related sectors were under consideration or review, then the TIM could be used to assess the economic implications of the subsidy or tax. Moreover, the TIM could be useful in estimating the size of the subsidy or tax required to achieve the desired economic impacts or policy objectives.

For example, if some sort of subsidy were under consideration in order to encourage industrial development in some of the tourism-related sectors, the benefits of such a program in terms of aggregate economic impacts, as estimated by the TIM, could be compared with the costs of the subsidy to assess the desirability of the subsidy from a governmental point of view. Moreover, the TIM could be used to indicate in part the amount of the subsidy which would optimize the benefit-cost ratio of such a subsidization scheme.

An additional example that belongs to this class of uses is the economic assessment of policies which restrict tourism development. For instance, if the government wished to restrict tourism (curtail expenditures in the tourism-related sectors), it may be interested to know the effect that such a policy would have on its own revenues. The TIM could be used to transform such a reduction in current expenditures into the corresponding reduction in the total sectoral demand for various commodities, both from current expenditures and from the capital feedback induced by them, and, therefore, into the resulting reduction in the governmental revenues from indirect or commodity taxation. The TIM

could also be used to estimate the reduction in government revenues from lower incomes resulting from the loss of tourism expenditures, but this latter use of the TIM is less reliable. It is only appropriate for the federal government, and even then strong assumptions must be made concerning the distribution of the income foregone.

4. The TIM has the capability not only of estimating very aggregate economic impacts such as income generated, but also of providing rather disaggregated estimates of the commodity groups required for a given tourism-related expenditure. The national or provincial TIM user could therefore assess the national (provincial) balance-of-payments effect of the tourism-related expenditure if he also has information concerning the distribution of commodity flows between the nation (province) and the rest of the economy of which it is a part.

5. The TIM can be used to examine the labor intensiveness of the tourism industry. Whereas uses 1, 2, and 3 indicated that the TIM can be used to estimate the total employment, direct and indirect, generated by tourism expenditures, the TIM also has a more industry-specific use in that the direct employment created in each sector can be estimated. In other words, built into the TIM structure are the job-output ratios for each tourism-related sector. The job-output ratios reveal the employment in the sector in terms of the man-years that are required to produce a given amount of final demand in the sector. Hence, each sector of the tourism industry can be examined with respect to the relative efficiency of labor.

6. Inferences can be drawn about the significance of capital feedback in the tourism-related sectors by examining the size of the investment generated in the sectors. For example, a government policy-maker may wish to know in aggregate terms the size of the investment that is required to support additional tourism expenditures. A comparison of the size of the additional investment with the value of the discounted stream of the corresponding expected tourism economic impacts would demonstrate the economic desirability of such investment from the public point of view. Similarly, if the induced investment were known or anticipated to be forthcoming privately, the effects of increasing tourism demand (expenditure) in the nation or province could be traced out with respect to attracting private investment.

7. The capital intensiveness of a tourism-related sector, as opposed to the absolute size of the capital required by the sector, can be examined by observing the capital feedback into the sector relative to the current expenditures in that sector.

8. In order to plan extensively for the orderly expansion of an industry, the extent to which the industrial development is deterministic, in both a static and a dynamic sense, needs to be known. In terms of a static analysis, the TIM can provide an indication of the "noise" or unexplainable variation in the expansion of each sector by the goodness of fit or the determinism of the corresponding investment function. Moreover, the extent to which both the theoretical structure of the sectoral investment function conforms to plausible economic theory, and also the extent to which the empirically-estimated parameters explain the investment variation in the sector can be observed from the TIM's investment functions. In other words, the specification of each investment equation or the explanatory variables chosen to estimate each type of investment can indicate the theoretical rationale of each investment function. Secondly,

the proportion of variation in each sectoral investment which is statistically explained by those variables can indicate the empirical reliability of each equation. Hence, in some circumstances, the TIM can be used to make judgments about both the expected reliability of the effectiveness of tourism policies designed to influence investment in tourism-related facilities, and also the expected reliability of tourism-related investment being induced by the normal or unassisted operation of the tourism industry.

In addition, the length of the lag of the variables affecting tourism development (investment) can indicate the dynamic determinism of the investment system. The longer the lags associated with the explanatory or "driving" variables in the investment functions, the more difficult it is to immediately alter the tourism development pattern without fundamentally altering the existing tourism industry.

9. Inferences concerning the capital markets utilized by the tourism-related sectors can be drawn from analyzing the structure of the TIM investment functions. For example, it is commonly believed that the tourism industry is one of the first industries to suffer in periods of high interest rates because many of the tourism-related establishments are small scale and have relatively little internal financing. Suppose an analyst wants to know the extent to which the tourism industry will suffer in terms of insufficient plant or capital construction as a result of, for example, massive governmental borrowing which can be expected to drive up interest rates. In such a case, the analyst can observe from the investment functions in the TIM the extent to which the tourism-related sectors rely on conventional private capital markets as opposed to financing generated from internal retained earnings, or any other nonmarket source. Such a determination can be made by examining the significance, if any, of the interest variable in the investment functions.

10. By observing the lag structure in the sectoral investment function, indirect information can be obtained concerning the process of capital accumulation in the industry. For example, a government tourism analyst might wish to examine the hypothesis that investment in tourism-related facilities is not responding to demand pressures because of insufficient information available to the entrepreneur, market imperfections, or other reasons. To check that hypothesis, the analyst could compare the time required for the construction of new facilities plus a reasonable informational lag against the investment lag estimated by the TIM investment function. Similarly, if the length of the capital adjustment process, as estimated by the TIM, is unacceptably long in the view of the tourism planners, a policy can be initiated to shorten the investment lag. This is one example of the many ways in which the TIM's empirically estimated parameters or lag structures can provide signals to the tourism policy-makers that the structure of the tourism industry under their jurisdiction needs to be modified.

11. The TIM may be used to indicate the extensiveness or comprehensiveness of governmental action necessary to modify the behavior of the tourism industry. On the one hand, if the development of the industry is induced more or less automatically by current expenditures in the various sectors, then the only major problem in achieving tourism development is controlling or stimulating demand, i.e., current expenditures in the industry are the primary determinant of the future capital flow. On the other hand, if there is significant autonomous investment in a tourism-related sector, or if the capital feedback from current

expenditures is not sufficiently strong, then the industry must be developed by direct investment and institutional modifications as well as by stimulating or controlling tourism demand. The TIM investment functions reveal the extent of the autonomous investment as well as the capital feedback from current expenditures in the sector. Thus, the TIM reveals the homogeneity, or the absence of homogeneity, in the investment functions of the tourism-related sectors, and this empirical knowledge has many theoretical economic uses.

## CONCLUSIONS

The TIM provides a systematic quantitative framework for transforming tourism expenditures into the corresponding economic impacts like employment, income, and governmental revenues. The model has many practical uses, especially when used for interindustry comparisons with respect to economic impact.

The methodology reveals a comprehensive set of data requirements to uniformly describe certain economic impacts at the regional level. Also, the model can accommodate a multitude of socioeconomic impact extensions.

The structure of the TIM is consistent with an economic theory. In particular, the econometric or behavioral portion of the TIM, the investment functions, has a structurally consistent and theoretically sound specification. Conversely, since a theoretically consistent specification succeeds in producing econometrically estimated investment functions that are empirically valid and good-fitting, there is evidence that the economic theory underlying the TIM accurately reflects the behavior in the tourism industry.

The econometrically estimated coefficients of the general specification of the TIM investment functions,  $\hat{\alpha}$ ,  $\hat{\beta}$ , and  $\hat{\gamma}$  of Eq. 11, for example are composite factors that represent the net effect of several time-dependent variables. The estimated values of the coefficients are average values over the time period for which the investment functions were estimated. The composite coefficients are reliable as long as the component variables change relatively slowly.

## APPENDIX I.—REFERENCES

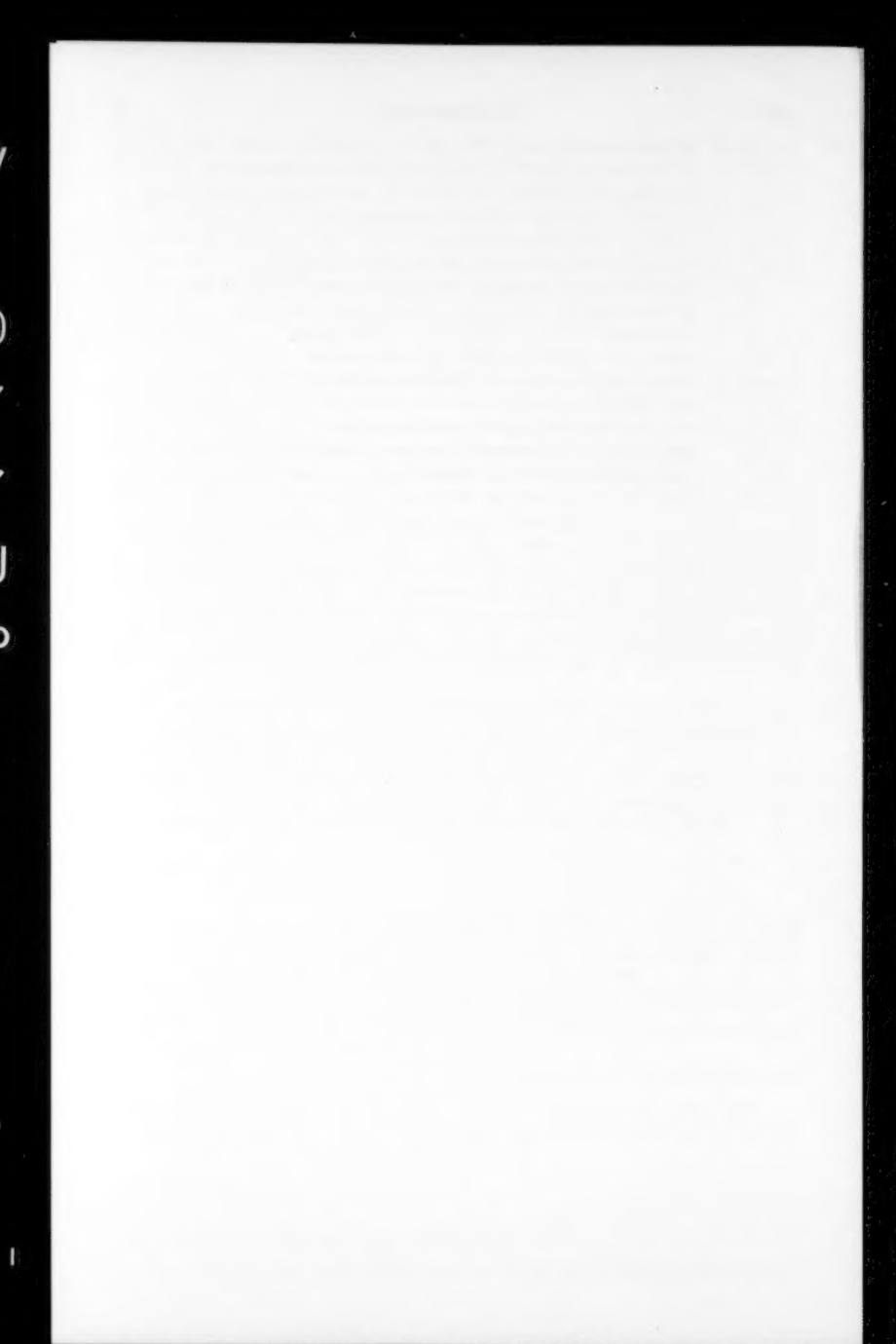
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## APPENDIX II.—NOTATION

*The following symbols are used in this paper:*

$C$  = accelerator term or the rate of change in investment activity in a

- tourism-related sector,  $C_t = [(I_t - I_{t-1})/I_{t-1}] (100)$ ;
- $C^c$  = accelerator for total construction activity in Canada;
- $C^{c3}$  = investment accelerator for Sector 3;
- $C^p$  = accelerator term for private investment;
- $E_t$  = tourism expenditure in a sector;
- $G_t^r$  = total government revenue generated by tourism sales;
- $I_t$  = total investment in sector resulting from total sales;
- $I_t^p$  = private investment in sector resulting from total sales;
- $I_t^r$  = investment in sector induced by tourism sales;
- $N_t^r$  = total employment generated by tourism sales;
- $r_t$  = rate of interest; chartered banks prime rate;
- $S_t$  = total sales in a sector;
- $Y_t^r$  = total income resulting from tourism sales;
- $Z_{66}^I$  = price index for investment; base year, 1966; and
- $Z_{66}^{1,2,3}$  = price index for sales in TIM Sectors 1, 2, and 3; with base year, 1966.



## URBAN IMPACTS OF EPA'S CONSTRUCTION GRANTS PROGRAM

By Richard R. Noss,<sup>1</sup> A. M. ASCE and David H. Marks,<sup>2</sup> M. ASCE

### INTRODUCTION

Engineers, planners, and urban developers are responsible for the provision and management of the infrastructure serving society's needs. The characteristics of such work are often shaped, advertently or inadvertently, by federal and state public works programs and other forms of assistance. One such program is the Environmental Protection Agency's (EPA) Construction Grants Program for publicly owned wastewater treatment facilities (established by Section 201 of the Federal Water Pollution Control Act Amendments of 1972, the "Act"). The purpose of this paper is to identify the impacts of the Construction Grants Program on urban areas. By bringing the implications of this program to the attention of engineers and planners who must work within the confines of such programs, as well as the legislators who create and the bureaucrats who regulate the programs, it is hoped that a more complete understanding of the process can be gained. What follows is in essence a brief impact statement on the federal government's waste treatment Construction Grants Program as it affects urban areas.

This assessment was developed from a national perspective. Readers interested in specific local impacts are referred to the series of studies by the Urban Institute (14). The objective of this paper is to identify characteristics of the Construction Grants Program, as it has been administered by the EPA, which induce significant departures from the status quo in urban areas. Future work should identify how these impacts support or work against present or desired urban policies and recommend appropriate changes. Some general recommendations are presented at the end of this paper, but a full analysis of the relationship between impacts and policies was beyond the scope of this work.

This assessment is organized around seven major categories of impacts:

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<sup>1</sup>Asst. Prof. of Civ. Engrg., Univ. of Massachusetts, Amherst, Mass.

<sup>2</sup>Prof. of Civ. Engrg. and Asst. Dir. of the Ralph M. Parsons Lab. for Water Resources and Hydrodynamics, Massachusetts Inst. of Technology, Cambridge, Mass.

Note.—Discussion open until April 1, 1982. To extend the closing date one month, a written request must be filed with the Manager of Technical and Professional Publications, ASCE. Manuscript was submitted for review for possible publication on February 26, 1981. This paper is part of the Journal of the Urban Planning and Development Division, Proceedings of the American Society of Civil Engineers, ©ASCE, Vol. 107, No. UP1, November, 1981. ISSN 0569-8081/81/0001-0033/\$01.00.

1. The magnitude and distribution of the benefits of improved water quality.
2. The capital expenditures burden.
3. The incidence of operation and maintenance costs.
4. The overall effects on local government financing.
5. The employment opportunities associated with wastewater treatment.
6. The effects of wastewater facilities on urban growth and development.
7. The problems faced by older communities due to their aging infrastructure.

These impacts of the Construction Grants Program were assessed by compiling and evaluating information from three types of sources; published materials relating to the Construction Grants Program or the impact categories, discussions with agency personnel and with other professionals in related areas, and local experiences with Construction Grants projects. The fundamental consideration is not the collection of facts about the Construction Grants Program and urban areas but to evaluate those facts from a specific (new) perspective to identify the impacts on urban areas.

There are many other less tangible effects induced by the Construction Grants Program. Typical effects include stress on the social fabric or political system of a community due to differences of commitment to environmental quality objectives or to pressures induced by the financial burdens of the Act. Conversely, some communities have used wastewater planning as a vehicle for local growth policy planning and have thereby achieved heightened community cohesiveness and consensus. To many communities, the Construction Grants Program and the other requirements of the Act with which it is coordinated, such as the minimum treatment requirements, are a great imposition, forcing them to undertake expensive activities that would otherwise be far down their list of priority actions. To a few communities, though, the regulations and delays associated with the Construction Grants Program have prevented them from implementing local water quality enhancement programs that may in the short or long run have proved to be more effective and efficient than the plans finally approved by EPA. On a local level, the most salient impacts are often due to the siting of the wastewater treatment facilities.

It is difficult to discuss these nonquantifiable or less tangible impacts in general terms. This is not to belittle their significance, only to recognize that it is far easier to address more quantitative impacts when focusing on larger scale effects.

Much of the discussion herein addresses the negative impacts of the program. This is not meant to imply that the disbenefits of the Construction Grants Program outweigh the benefits. The Construction Grants Program was established for a single purpose, to assist local communities in meeting the financial burden of the wastewater facilities construction mandated by the 1972 Amendments. In this regard it has been highly successful. Indeed, given the high cost of wastewater facilities, it is likely that significantly less construction would have taken place if there were no Construction Grants Program. The focus of this paper is on the secondary impacts of the program. The question is: "How can the Construction Grants Program be fine-tuned to minimize the adverse impacts on urban peoples and areas and to complement more fully other federal programs and policies for urban areas?"

In order to understand the impacts of the Construction Grants Program, one must first understand the program itself. In general, the impacts have followed

and will follow the expenditures. Which projects are funded in a state, how much money each state receives, and what the future expenditures under the program will be, all follow directly from the procedures and regulations of the Construction Grants Program. The following section describes these activities which exert so much influence upon the incidence of the impacts of the program. Following the discussion of the seven categories of effects enumerated above, the paper concludes with a series of recommendations that could mitigate some of the adverse effects of the program that have been identified.

#### CONSTRUCTION GRANTS PROGRAM

The Construction Grants Program was established by the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) and amended by the Clean Water Act of 1977 (PL 95-217). Its purpose is to assist municipal and regional governments in providing the wastewater transmission and treatment facilities necessary to meet the requirements of the act.

The Construction Grants Program is also a massive public works program with expenditures of about \$4 billion per yr. The EPA's objectives in developing criteria to spend these monies are to assure that water quality standards are met and to assure that all municipalities install the wastewater facilities mandated by the Act. These expenditures may also result in significant impacts on urban areas, impacts which could conflict with or support the objectives of other federal programs.

The funds appropriated by Congress for the Construction Grants Program are allocated among the states according to a complex formula based on population and the total wastewater facilities needs to serve year 2000 population and development as estimated by the biennial EPA "Needs Survey" (11,12). Minimum levels of treatment are specified in the Act, but higher levels may be required by the states after case-by-case analyses. The states are also responsible for the development of the Project Priority List used to allocate funds among competing projects within the state. Thus, many of the impacts of the Construction Grants Program are determined by state water pollution control policies.

The Construction Grants Program will pay 75% of the cost of planning and constructing approved facilities and 85% of the cost if innovative or alternative methods (as defined by EPA) are used. In addition, 30 states provide grants ranging from 5-25% for the construction of wastewater facilities.

The following categories of projects are eligible for funding under the Construction Grants Program: (1) Secondary treatment, (2) more stringent treatment; (3a) inflow/infiltration correction, (3b) major sewer system rehabilitation; (4a) new collection sewers and appurtenances (for development "in existence" in October 1972), (4b) new interceptors and appurtenances, and (5) correction of combined sewer overflows.

**Performance of Program to Date.**—The extent of financial assistance provided by the Construction Grants Program depends upon: (1) Annual appropriations by Congress; (2) allocation of appropriated amounts among the states; and (3) the actual obligation of funds by state agencies and regional EPA offices for wastewater facilities planning or construction projects. Funds not obligated by a state within two years are reallocated among those states that have exhausted their allocations. Obligating funds means making commitments in the form of

construction (or planning) contracts; the actual expenditures will extend well beyond the two-year period. In theory, this should move unneeded money to states which are able to spend it. In practice, however, it has caused states to place undue emphasis on moving the money out so they don't lose it to reallocation. Low priority projects are often funded because they are ready to go while high priority projects receive little attention if it is evident that a grant cannot be made to them before the end of the fiscal year (13). In spite of the tendency to fund any project ready to receive a grant, EPA estimates that 30 states will not use any of their Fiscal Year 1980 funds until Fiscal Year 1981 or later. Only 12 states (and four territories) will use more than half their 1980 funds before the end of Fiscal Year 1980 (13). Part of this problem is due to the historical backlog of projects, part is due to inadequate state agency staffing, and part is due to an over-bureaucratized funding process.

The Construction Grants Program is actually a metamorphosis of an ongoing program providing financial assistance to the construction of municipal wastewater treatment facilities. Between 1956 and 1972, the earlier program provided \$5.2 billion in grants (at lower rates of federal participation) to almost 14,000 projects. Many of the projects funded by the current Construction Grants Program were conceived, and in some cases completely designed, under the requirements and philosophy of the earlier program.

TABLE 1.—Summary of Grant Awards

Step (1)	Number of grants (2)	Total, in dollars (3)	Number completed (4)	Amount (5)
1	7,510	700 million	2,397	162 million
2	3,515	743 million	1,813	286 million
3	5,255	19.4 billion	1,304	1.3 billion

Before a project can be constructed, it must first complete a two-step planning process. These steps are known as Step 1, Preliminary Facility Planning; Step 2, Detailed Design and Specifications; and Step 3, Construction. EPA has obligated \$20.8 billion under the 1972 program for 16,280 Step 1, 2, and 3 grants (as of May 10, 1979) (Table 1.). Of the 3,951 (\$18.1 billion) active Step 3 projects, 515 (\$1.9 billion) have not yet begun actual construction for a variety of (mostly local) reasons. All but one of the completed Step 3 projects were already in the pipeline when the Act passed.

The program appears to treat large and small communities equally in its funding criteria. Table 2 compares the population served by projects which have been awarded grants and the distribution of U.S. population by community size. Rural populations have been excluded from the final column of the table because, except in rare instances, they are not eligible to receive grant funds. It appears that large communities, those over 500,000, are receiving slightly more than their proportionate share of grant funds. Although comprising about 23% of the population, they received at least 28% of grant funds. They may actually be receiving significantly more funds, since it cannot be determined how many

of the projects listed as serving populations smaller than 500,000 were actually projects serving portions of larger metropolitan areas. (EPA categorizes projects according to the population served rather than the population of the community in which the project is located.) Although communities of less than 10,000 persons do not appear to be receiving "their share" of construction grant funds, many of these communities are not served and do not need to be served by centralized sewage collection and treatment systems. Others take advantage of the Farmers Home Administration's sewer and water programs which are limited to communities of less than 10,000 in population. In general, then, the program does not appear to be seriously biased with respect to the size of the community to be served by proposed projects.

TABLE 2.—Construction Grant Awards as of March 7, 1979

Population served (1)	Grant Awards		Grant Awards		Approximation of U.S. population by community size, as a percentage (6)
	Number (2)	Percent of total (3)	Dollars, in millions (4)	Percent of total (5)	
Under 3,500	7,633	49.0	1,631	8.1	—
3,501–5,000	918	5.8	554	2.7	24
5,001–10,000	1,775	11.4	1,428	7.1	—
10,001–25,000	1,903	12.2	2,660	13.2	13
25,001–50,000	1,056	6.8	1,921	9.5	12
50,001–125,000	960	6.1	3,236	16.0	14
125,001–250,000	446	2.9	1,681	8.3	7
250,001–500,000	261	1.7	1,349	6.7	7
500,001 and over	645	4.1	5,707	28.4	23
Totals	15,587	100%	20,167	100%	100%

Note: Does not include rural population nor increases to old law projects.

**Future Needs for Wastewater Facilities Construction.**—EPA estimates the cost of meeting the requirements of the Act in each state every two years. These estimates are published in the Needs Surveys. The estimates are made for two categories: the costs of backlog needs to meet 1977 treatment standards with sufficient capacity to serve the population that was in place in that year, and the cost of meeting more stringent 1983 standards with a capacity to serve the estimated population of the community in the year 2000. Table 3 sets out the results of the 1978 Needs Survey.

Despite the emphasis on needs in both the allotment of funds among states and the prioritization of projects within states, some areas have needs that have hardly been addressed by the Construction Grants Program. The most striking example is the New York City metropolitan area (11). New York City accounts for \$7.2 billion of the New York metropolitan area's \$10.8 billion of needs (Categories 1–5). However, while the Construction Grants Program

has reduced the metropolitan area needs by 10% since the 1976 Needs Survey, the New York City needs remain unchanged. The 1978 Needs Survey (11) comments

This situation is not unique to New York, but is a common occurrence in financially troubled cities, which have little prospect of financing the local share of more than a small percentage of their wastewater treatment and conveyance needs. The national total of needs in the ten most financially distressed large cities is about \$15 billion.

While it is true that the wastewater facilities' needs facing some communities are large relative to their ability to afford capital expenditures, few communities actually face a financial inability to afford the local share. (Those with problems are primarily small communities that have reached their borrowing limit or those whose citizens are on low and fixed incomes.) The problem really is one of local priorities for capital expenditures. In distressed communities, which have

TABLE 3.—Needs for Wastewater Facilities, in billions of 1977 dollars

Category number (1)	Needs category (2)	Backlog needs (3)	Year 2000 needs (4)
1	Secondary treatment	9.66	15.09
2	More stringent treatment	10.63	20.51
3 <sup>a</sup>	Infiltration/Inflow	2.44	2.44
3 <sup>b</sup>	Replacement and/or rehabilitation	4.87	4.88
4 <sup>a</sup>	New collector sewers	19.02	19.02
4 <sup>b</sup>	New interceptor sewers	6.69	18.47
5	Combined sewer overflow	25.74	25.74
Total 1, 2, 4b		26.98	54.07
Total 1-4		79.05	106.15

many competing needs for capital investments, public agencies face the need for making choices between wastewater facilities and other equally—or more—needed capital projects. To date, they have often chosen to invest in other types of projects as is evident in the New York City case. Unless enforcement actions are strengthened, or unless other sources of capital funds are made available to assist in the local share of wastewater facilities, local priorities in these communities are unlikely to change, and extensive delays in the achievement of the Act's water quality objectives can be expected.

The federal share of the \$106 billion in year 2000 wastewater facility needs identified by the 1978 Needs Survey (Table 3) will be completely funded by the year 2000 if the present level of funding (in real dollars) is maintained. Thus, the identified needs can serve as a good basis for projecting the long term incidence of the costs and other impacts of the Construction Grants Program. In the short term, however, the distribution will be determined by the specific projects that receive grants, which in turn are affected by differences in local facility planning and preconstruction activities, limitations on the funds available,

restrictions on the eligibility of types of projects, and variations in the priority criteria assigned to project attributes.

#### CATEGORIES OF IMPACT

The Construction Grants Program is driven by the difference between the present and the desired water quality and by the difference between the extent and condition of existing wastewater facilities and those required to achieve the water quality standards. The impacts of the Construction Grants Program can be site-specific. The benefits of the program accrue to people primarily by virtue of their location relative to the water bodies whose water quality is improved. The primary benefits of improved water quality are associated with the introduction of new uses (especially recreation) rather than the expansion or augmentation of existing uses (2). Because proximity is a primary determinant of where people recreate, those located near waters to which recreational uses (especially swimming) are restored will be the primary beneficiaries. Urban areas in general suffer from poor water quality that precludes many recreational uses. They would, therefore, be among the major beneficiaries if and when higher levels of water quality are achieved (assuming that the facilities necessary to service those uses such as boat ramps, beaches, and other access to the water are available).

**Improved Water Quality.**—Although municipalities are significant sources of pollution, instituting treatment for them will not result in achievement of water quality standards unless all other sources of pollution are addressed as well. In many urban areas, combined sewer overflows and urban runoff are major sources of pollution. Both Congress and EPA have made the abatement of municipal and industrial sources of pollution top (and almost exclusive) priority. In many areas, however, abatement of urban runoff and, especially, combined sewer overflows represent more cost-effective pollution control measures than higher levels of municipal wastewater treatment (6). Abatement of these nonconventional sources of pollution will not be achieved in the near future, however, as state priority list criteria, and local, state, and EPA pollution control attitudes (and funding) are focused on the control of traditional point sources. Urban runoff pollution control measures are not eligible for Construction Grants funding by statute.

**Capital Costs.**—The aggregate costs of the Construction Grants Program are large, totalling \$106 billion to meet the year 2000 needs (categories 1–5) (\$392 per capita, nationally). Note that this does not include the cost of controlling stormwater runoff and providing collection sewers to areas developed after 1972 since these costs are not eligible for federal grants by statute.

The actual expenditures communities face vary considerably and depend primarily upon the extent, capacity, and condition of their existing wastewater infrastructure. Secondary influences upon local sewerage costs are the growth expected between the present and the year 2000, the water quality standards of the receiving water and the levels of treatment they entail, and the residential density of areas to be seweraged. Many small communities face exceptionally high per capita costs for wastewater management (7).

An EPA survey of 258 facility plans for communities with populations under 50,000 revealed that the total costs of the planned systems would

exceed \$100 per year for homeowners in 40% of the towns. For residents of communities with fewer than 10,000 people, projected annual costs approach \$300 and sometimes more per household. The problem is made more acute by the fact that many small town homeowners have incomes well below the national median.

According to the 1978 Needs Survey, 89% of the 22,768 existing and planned wastewater treatment plants are designed to serve populations of about 10,500 or less (assuming a sewage flow of 100 gals per capita per day). Of these, one-third (6,557) are projected for treatment more stringent than secondary by the year 2000. If (new) sewers are required, the capital burden of wastewater treatment systems increases greatly.

TABLE 4.—Wastewater Facility Needs in Major SMSA's

Standard Metropolitan Statistical Area (1)	Estimated 1975 population, in millions (2)	Needs Survey Category,* in millions of dollars						Total for categories 1-4 (9)
		1 (3)	2 (4)	3 (5)	4a (6)	4b (7)	5 (8)	
Atlanta	1.8	27	273	22	129	256	100	807
Baltimore	2.1	0	289	1321	70	100	0	2080
Birmingham	0.8	6	38	24	31	47	0	146
Boston	3.4	539	151	4	224	214	387	1519
Charlotte	0.6	0	53	11	35	47	0	146
Chicago	7.0	2	924	79	24	126	1711	2866
Cincinnati	1.4	2	91	4	70	108	463	738
Cleveland	2.0	0	194	89	30	171	410	894
Dallas-Ft. Worth	2.5	0	171	5	42	147	0	365
Denver	1.4	48	271	89	1	135	0	544
Detroit	4.4	15	573	42	47	234	1181	2092
Houston	2.3	0	383	102	116	279	0	880
Kansas City	1.3	319	79	5	70	318	390	1181
Los Angeles	7.0	480	352	0	34	32	0	898
Miami	1.4	123	0	16	211	178	0	528
Milwaukee	1.4	8	321	154	40	144	132	799
Minneapolis	2.0	3	446	13	5	169	109	745
Newark	0.34	413	222	34	63	95	777	1604
New Orleans	1.1	178	12	21	30	85	0	326
New York	9.6	1965	141	2772	548	364	1730	7520
Philadelphia	4.8	29	876	7	106	171	711	1900
Pittsburgh	2.3	37	108	1	74	18	430	668
St. Louis	2.4	383	40	57	41	291	523	1335
San Francisco	3.1	633	112	47	35	79	228	1134
Seattle	1.4	266	137	61	48	165	325	1002
Washington, D.C.	3.0	0	284	5	25	85	172	571

\* Needs survey categories include: (1) Secondary treatment; (2) More stringent treatment; (3a) Infiltration/Inflow; (3b) Replacement/Rehabilitation; (4a) New collector sewers; (4b) New interceptor sewers; (5) Combined sewer overflow.

The wastewater facility needs of major Standard Metropolitan Statistical Areas (SMSA's) are presented in Table 4. Although the bulk of the facility needs probably serve the center city, the needs of the outlying facilities may be significant for advanced waste treatment (category 2) and collector and interceptor sewers (categories 4a and 4b) in some cases. The combined sewer overflow needs (category 5) are center city needs as the most of the rehabilitation (category 3) and 1977-level treatment (category 1) needs. The relationship of facility needs to existing infrastructure is most clearly represented by category 1. Those communities which already provide secondary treatment have virtually zero needs in this category.

The needs estimates for rehabilitation of old sewer lines given in category 3 are approximate. Since most communities have not completed accurate, comprehensive evaluations of the condition of their sewer systems, these estimates are probably conservative. We suspect that the high needs identified for Baltimore and New York City reflect better information on the state of their sewers rather than necessarily poorer conditions.

The facility needs are expressed on a per capita basis in Table 5. No correlation between current fiscal condition and total per capita needs is apparent.

**Operating Costs.**—The operating costs of wastewater treatment facilities are determined primarily by the treatment processes involved. Economies of scale in operation and maintenance are observed up to approx 85 MGD (i.e., populations served of about 850,000) (9). Unit costs appear to increase for higher flows. The operating level of the treatment facility relative to its design capacity also affects the unit costs of treatment. Plants that include large amounts of excess capacity to account for projected future growth incur higher operating costs (and do not provide as efficient treatment) in the short run. These problems can be overcome by better facility design, especially staging of construction. EPA regulations to limit facility capacities will also address this problem.

**Effects on Local Government Finances.**—Aggregate state statistics compiled by the National Commission on Water Quality (NCWQ) (4) indicate that the local share of annual wastewater facility construction expenditures is less than 2.4% of total local annual revenues (with one exception). The NCWQ also found that over two-thirds of sewerage capital costs are financed through bond issues. Thus, when capital expenditures are annualized the actual budgetary amounts in local communities each year are much less.

As voters have become less willing to approve general obligation bond issues, municipalities have switched to the use of revenue bonds to fund wastewater facilities. Petersen estimated that "some 60% of all tax exempt bonds issued in 1977 were revenue bonds secured either solely or in the first instance by revenues from designated capital projects. Revenue bonds do not fall within most municipal debt limitations. Wastewater facility construction is well suited to revenue bonds because the user charge system is mandated by the Water Pollution Control Act.

**Employment.**—The Construction Grants Program is a significant public works program in its own right. An estimated 9,000 workers are employed in on-site construction for every \$1 billion in construction outlays and over 18,000 more are employed indirectly. EPA estimates that almost 30% of the cost of building a sewage treatment plant goes to labor (8). If the entire \$106 billion of needs through the year 2000 are funded, the Construction Grants Program will increase

personal income by \$60-90 billion nationwide based on 1979 dollars using multipliers from 2 to 3:1, or an average of \$3-4.5 billion per year. It appears that over the long run Construction Grants funds and, thus, direct employment opportunities will be distributed roughly in proportion to population. Experience with mass transit and public building construction indicates that public construction projects employ relatively greater percentages of minority workers than private sector projects. Estimated employment impacts due to wastewater

**TABLE 5.—Comparison of Per Capita Needs for Selected Categories of Wastewater Facilities by SMSA with the Fiscal Need Ratings of the Center City**

City (1)	Congressional Budget Office Composite Measure or Fiscal Need (City)		Urban Devel- opment Action Grants, index, by city (4)	SMSA Wastewater Needs, in dollars per capita				
	Score (2)	Rank <sup>a</sup> (3)		1977 treat- ment and rehabil- itation (5)	Inter- ceptor and col- lector sewers (6)	Ad- vanced waste treat- ment (7)	Com- bined sewer over- flow (8)	Total cate- gories I-V (9)
Washington, D.C.	84	1	5	2	36	95	57	190
Boston	72	2	6	159	129	44	114	447
New York	67	3	6	493	95	15	180	783
Newark	65	4	7	1315	464	652	2221	4718
St. Louis	61	5	7	183	138	17	218	556
Philadelphia	53	6	6	8	58	0	148	396
Baltimore	52	7	6	629	81	280	0	990
Detroit	46	8	6	13	64	130	270	475
Birmingham	46	10	6	38	98	48	0	182
New Orleans	45	11	7	180	104	11	0	296
Buffalo	44	13	7	93	192	34	898	1210
Cincinnati	44	14	7	5	127	65	330	527
Cleveland	42	16	7	45	101	97	205	447
San Francisco	39	17	5	219	36	36	74	366
Pittsburgh	37	18	7	17	40	17	185	290
Louisville	35	20	6	175	1159	293	821	2449
Denver	33	22	5	98	97	194	0	389
Miami	31	23	3	99	279	0	0	377
Minneapolis	23	31	4	8	88	223	55	373
Phoenix	18	33	1	88	91	0	0	179
Los Angeles	18	34	5	69	10	50	0	128
San Diego	17	35	1	513	234	41	0	788
Seattle	13	36	4	233	152	98	232	716
San Jose	12	37	1	25	261	177	0	462

<sup>a</sup>Taken from a ranking of 38 cities on a composite measure of fiscal need.

facilities construction through the year 2000 for selected metropolitan areas are presented in Tables 6 and 7.

Operation of wastewater treatment facilities employed over 40,000 employees in 1974. Small facilities require disproportionately more employees than large ones (5.1 versus 1.5 per 10,000 served for communities of under 10,000 and over 100,000, respectively) (3). Another 45,000 operators are expected to be needed by 1985. Over half of the new operators are needed for treatment facilities

serving 10,000 or fewer persons. The majority of sewage treatment jobs are low skill.

**Growth Effects.**—The provision of wastewater facilities, especially interceptor sewers, can have significant growth inducing effects. This is especially true

**TABLE 6.—Estimated Employment Impacts due to Wastewater Facilities Construction through the Year 2000, based on Total Needs in Categories 1-5**

Standard Metropolitan Statistical Area (1)	Urban Development Action Grants Index by city (2)	On-site wastewater facility construction employment, in person-years (3)	Wastewater treatment plant personnel (4)
Buffalo	7	4,100	60
Cincinnati	7	6,200	215
Cleveland	7	7,600	305
Newark	7	13,600	50
New Orleans	7	2,700	170
Pittsburgh	7	5,700	350
St. Louis	7	11,300	370
Baltimore	6	17,700	320
Birmingham	6	1,200	120
Boston	6	12,400	520
Detroit	6	17,800	675
Louisville	6	6,900	50
New York	6	63,900	1,470
Philadelphia	6	16,200	735
Denver	5	4,600	215
Los Angeles	5	7,600	1,070
San Francisco	5	9,600	475
Washington, D.C.	5	4,800	460
Minneapolis	4	6,300	305
Seattle	4	8,500	215
Miami	3	4,500	215
Phoenix	1	1,000	100
San Diego	1	5,200	120
San Jose	1	2,200	85

**TABLE 7.—Wastewater Treatment Plant Employment for Populations of Different Sizes**

Population size group (1)	Employees per 10,000 population (2)
<10,000	5.14
10-25,000	3.76
25-100,000	2.80
>100,000	1.53

in cities where regionalization (encouraged by the Act) to take advantage of the economies of scale in construction and operation and maintenance of treatment facilities has led to the construction of interceptors through large areas of underdeveloped land. This in turn has encouraged dispersed development patterns and consequent problems of inefficient use of land and high local service costs.

The classic example of the effect of sewerage on the development of vacant land is the experience of Fairfax County, Virginia, in the 1960's and early 1970's (5). The Pohick Creek watershed, located in the southwestern portion of the county was expected to be one of the fastest growing portions of the county through the year 2000. In order to prevent scattered development, the county planning staff and taxpayer groups proposed a holding zone in the master plan for the watershed. The holding zone status would have kept the area free from development until a later time when it could be developed efficiently. However, at the same time that the county supervisors approved the master plan containing the holding zone, they also approved the extension of an interceptor sewer in the watershed. Due to the resultant pressure from developers to tie into the available capacity in the sewer and the lack of coordination among the regulatory boards involved, within months, the area had begun to develop. Thus, sewer-induced development occurred even in an area explicitly set aside as not-to-be-developed.

Although the Fairfax experience is unusually well documented and clear cut, it is typical of the general phenomenon: the pressure of developers coupled with the availability of sewerage will virtually always overcome stated public policies, and even zoning ordinances, designed to prevent development. A study of EPA interceptor projects in the early 1970's observed

in every case . . . the stated primary purpose of each sewer project was to correct existing pollution problems, not to plan for growth . . . but it is not coincidence that in every case continued growth is planned and that it is clearly contingent upon construction of wastewater management facilities. (1)

The most important "growth-inducing" factor of interceptor construction is the amount of "reserve capacity" (sometimes called "excess capacity") provided over and above the capacity needed to serve existing development. The argument has been that it is cheaper to provide capacity for future development in the original installation than to put in another interceptor at a later date if and when that development occurs. The high initial cost and greater economies of scale in interceptor construction make this argument intuitively appealing.

EPA's requirements for "cost-effective" sizing of all wastewater facilities have lent legitimacy to the provision of large amounts of reserve capacity. As Binckley, et al. (1) point out, the use of high per capita flows, high population projections for the service area, and disregard of staging policies has resulted in the provision of significant amounts of excess capacity in many cases in spite of the cost effectiveness requirements. Binckley, et al. looked at a 52-project sample of projects likely to have high amounts of reserve capacity. Table 8 identifies the five measures of excess capacity used and summarizes the statistics of the sample.

The development impacts of reserve capacity in interceptors are often exacer-

bated by local financing arrangements. Most financing schemes are designed to have the new users pay for the cost of the interceptor. The pressure to get new users hooked up to generate the income can become intense, forcing interceptor design projections to become self-fulfilling prophecies.

In late 1978, EPA published (final) revised regulations for the Construction Grants Program designed to reduce the secondary impacts of wastewater projects (10). These regulations apply to facility plans initiated after June 26, 1977, but do not apply to plans started before then. The changes should: (1) Reduce the amount of reserve capacity provided; (2) reduce the design and staging periods of facilities; (3) discourage the location of facilities in environmentally sensitive areas; and (4) require fuller evaluation of the primary and secondary impacts of facility construction. Most of these measures are implemented through EPA's revised Cost Effectiveness Analysis Guidelines for Construction Grants Projects.

The likely effect of these new regulations will be to include less reserve

TABLE 8.—Indicators of Excess Capacity

Measure (1)	Mean (2)	Median (3)	Standard deviation (4)
Design life, in years	116.0	51.0	116.0
Ratio of ultimate population to existing population	7.1	3.8	7.2
Implied annual growth rate, in percent per year	7.0	2.0	—
Size of sewer area, <i>A</i>	21,199.0	7,998.0	—
Percent of vacant land	61.0	62.0	11.0
Dollar cost per capita of excess capacity (assumes scale factor = 0.5)	145.0	100.0	159.0

capacity and to include more involvement by planners and interested citizens in the routing of interceptor sewers. Over the long term, these should reduce or eliminate the pressure to connect users to the system in order to pay for the facilities and should lead to better planned development along interceptor routes. Over the short term, however, because most projects which are in the planning stage are exempted from these requirements it will take a considerable period for the new regulations to have their intended effect.

**Problems of Older Communities.**—Old cities often experience special problems associated with the age of their wastewater infrastructure. The most important problems in the short term are the combined sewer overflows, mixtures of raw sewage and stormwater that currently discharge untreated to nearby streams during most rainstorms. (The current engineering practice is to build separate sewers for sewage and stormwater.) The abatement of combined sewer overflows is estimated to cost over \$25 billion. According to EPA, 77 major cities, including 10 of the country's 14 largest, have combined sewer overflow control needs of \$50 million or more (11). Because of their nature and location in highly developed areas, the cost (and engineering difficulty) of controlling each individual overflow is extremely high. But, also, by virtue of their location, the populations

which would benefit from their cleanup are substantial. Yet combined sewer overflow controls have historically received low priority. A much greater level of effort in research, development, and construction is necessary in this area.

Another major problem facing older cities is the deteriorating quality of their existing infrastructure. Some portions of the oldest systems date to the turn of the century. Wastewater facilities, including pipes, need constant maintenance and a regular program of rehabilitation or replacement. Rehabilitation, replacement, and maintenance are among the first items to be deleted when city budgets are tight, however. Consequently, the existing facilities deteriorate to the point where only emergency repairs are done. Over the long run a policy of performing only emergency repairs is much more costly, inefficient, and socially disruptive than a regular program of maintenance and rehabilitation.

#### MEASURES TO MITIGATE ADVERSE IMPACTS

Our review of the impacts of the Construction Grants Program has revealed that many impacts are due to local planning and administration of the program. However, there are mitigating measures that could be adopted by the EPA and the Congress to minimize some of the adverse impacts identified above. These are organized below according to the aspect of the program to which they respond.

**Allocation Formula.**—To the extent that funds are distributed on any basis other than needs (e.g., population or minimum allocation levels), they will not be available where the needs are. This will become increasingly important as the number of projects applying for Construction Grants funding increases. The allocation formula should be changed to include only the needs for wastewater facility construction.

The present two year period for obligating Construction Grants funds places too much pressure on states to spend the money and results in low priority projects being funded. Extending the period to three years would increase the quality of projects funded and permit better long-term management of the state priority list.

**Eligibility and Priorities for Funding.**—The costs involved in repair, replacement and rehabilitation of old facilities are large because of their location in densely developed areas and the crisis atmosphere prevailing when problems manifest themselves. Many of these facilities will require major repair, replacement, and rehabilitation expenditures in the near future to maintain their present level of service. The EPA must begin to shift its focus from providing new facilities to presently unsewered or underserved areas and must develop and fund programs (with appropriate priorities) to maximize the return on past investments.

Combined sewer overflows are often more significant sources of pollution than existing point source discharges yet they have not received sufficient attention in many areas. EPA should put more pressure, via priority criteria and planning activities, on state agencies to focus more attention on these problems. Furthermore, research and development work to identify and refine less expensive abatement techniques must be given high priority by EPA.

Unlike larger cities, small communities are well suited to land-intensive treatment processes. Thus far, however, the wastewater engineering profession has attempted to meet the needs of small towns by downsizing facilities originally

designed for larger towns. Active involvement by EPA is necessary to promote less technology-intensive alternatives to ease the burden of wastewater treatment for small communities. Where state agencies are unwilling to take risks on innovative alternative treatment projects, the EPA must assume the leadership role, either by essentially unilaterally approving them as Construction Grants or by funding them as demonstration projects. EPA must play a technology-forcing role.

Wastewater facilities impact urban development and urban inhabitants in many ways. One of the most direct means of mitigating the program's impacts is through the governing regulations. The Department of Housing and Urban Development should be representing the urban viewpoint(s) in all proposed changes in the regulations and program requirements memoranda and in informal reviews of the program and its impacts with EPA personnel.

**Program Management.**—As the easy projects are completed, more active state involvement in instigating and facilitating local grant applications will be necessary to keep the program moving. Specific persons should be designated to shepherd problem situations and to coordinate and advise local actions. This could be easily accomplished by EPA through Section 205 (g) Annual Agreements covering the expenditure of federal grants for state Construction Grants Program management activities. As more and more responsibilities are delegated to the states, with EPA's consequent lessened influence over the management of the programs, the establishment of high quality state water pollution control programs must be given the highest priority by EPA.

Short case histories describing successful, innovative projects are needed by small-town sewer agencies and committees to educate them in the full range of alternatives available. These case histories could also serve as vehicles for publicizing the recent improvements in EPA's administration of the Construction Grants Program and as foci for interactions with other agencies, such as on multiple-purpose projects.

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14. Urban Institute, "Urban Capital Investment Needs," U.S. Department of Housing and Urban Development, 1980.

## DISCUSSION

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## DISTRIBUTING REGIONAL SERVICES COSTS<sup>a</sup>

Closure by Lewis A. Rossman,<sup>5</sup> M. ASCE

The writers appreciate the interest shown by Heaney and Dickinson in their paper. In reviewing the game theory literature it is evident that numerous solution concepts have been proposed. If the criteria behind these concepts were complementary or synonymous with each other, then why are there differences produced in the numerical results?

The writers feel that most solution concepts can be classified into two categories. The first, which has been labelled stability, views the game as a dynamic bargaining or strategic process where each player or coalition attempts to obtain as much payoff (or lowest costs) as possible. Solution concepts in this category search for equilibrium or stable points wherein no individual or group can make an unchecked, more desirable improvement in his or its position. Rationality and bargaining strength, not necessarily equity, are the principles behind these approaches. Example of solution concepts in this category include Von Neumann-Morgenstern stable sets, the core, the bargaining set, and the kernel.

The second category uses a value theory to arrive at a unique division of payoffs (or costs). The value theory may use arguments related to equity, reasonableness, or concepts of fair division. The Shapley Value and the nucleolus are two examples. Many nongame theoretic cost distribution procedures, such as the SCRB Method, could be placed in this category.

The writers have attempted to accommodate both types of solution concepts in their cost distribution procedures. It was recommended that a cost distribution within the core that comes closest to matching a distribution based on some value theory be chosen. When a core does not exist, one should attempt to minimize the violation of the core's stability conditions. A linear programming procedure, based on a lexicographic Tchebycheff norm, was developed to carry out these ideas. Several types of value theory solutions were proposed for the procedure, but the writers specifically avoided stating that one was superior to another.

The discussers suggest that the usual game theoretic interpretation of equity and stability is to give preference to cost distributions that are closer to the center of the core, since they more equitably apportion the available savings. The writers find this statement rather vague in the sense that no quantitative definition of the center of the core nor of an equitable distribution of savings is provided. The discussers have not cited, nor have the writers been able to locate any references to the center of the core as a desired solution in game theory literature. (Spinetto (18) develops an  $\ell_p$ -center of a game, but in the  $2^n - n$  2-dimensional space of coalitions and not the  $n$ -dimensional space of cost vectors to which the discussers seem to be alluding.)

<sup>a</sup>January, 1979, by Lewis A. Rossman and Patricia Ann Graham (Proc. Paper 14284).

<sup>5</sup>Operations Research Analyst, U.S. Environmental Protection Agency, Cincinnati, Ohio.

The discussers compare the SCRB method and the nucleolus solutions with the solutions presented by the writers in their Example I. The discussers conclude that the writers' methods of cost distribution are not as good as other accepted methods because they do not lie as close to the geometric center of the core. Two observations regarding this point can be made. First, the writers' procedures would have chosen either the SCRB or the nucleolus solutions as the preferred cost distributions had they been used as the ideal distribution when defining equity index A. The writers noted that the choice of an ideal distribution was up to the analyst. They chose to use another ideal distribution, based on the facilities method, for illustrative purposes.

Secondly, the preferred cost distribution under equity index B does not lie in the center of the core in the 3-dimensional space of cost vectors because it is based on minimizing the spread in savings per unit of flow among coalitions, and not on total savings alone. If the core were plotted on axes defined as the savings per unit of service provided for each community (i.e.,  $[C(i) - c_i]/q_i$ ), then one would find that solution 2B lies at the geometric center. The other solutions would not. In terms of savings per unit of service, solution 2B provides 2¢, 6¢, and 6¢/1,000 gal to communities 1, 2, and 3, respectively. The nucleolus gives savings of 2¢, 10¢, and 4.4¢/1,000 gal, respectively. It would appear that solution 2B provides a more equitable distribution of savings per unit (or per user) of service.

The latter observation raises the issue of whether weighting by quantity of service the stability and equity criteria in the writers' procedures distorts the equity of the resulting cost distributions. The writers chose to use this weighting for two reasons. First, it seems reasonable that if two coalitions of communities enjoy the same total cost savings, then the savings of the coalition using less service (because it has fewer users of the service) should be given more weight. If the savings are passed on to the users in terms of lower user charges, then it would appear that users in the coalition using less of the service can obtain more benefits. Secondly, there is empirical evidence that public agencies like to look at their costs in terms of per capita or per user expenditures since this allows a simple price structure to be developed. A survey of water resources planners in the Meramec River Basin indicated that the preferred pricing system for sewage disposal was one using a single per unit price for each individual residential unit (19). Should these arguments prove unconvincing, the writers would like to point out that their cost distribution procedures could also be applied without using quantity of service as a weighting factor.

#### APPENDIX.—REFERENCES

18. Spinetto, R., "The Geometry of Solution Concepts For N-Person Cooperative Games," *Management Science*, Vol. 20, No. 9, May, 1974, pp. 1292-1299.
19. Loehman, E., et al., "Cost Allocation for a Regional Wastewater Treatment System," *Water Resources Research*, Vol. 15, No. 2, April, 1979, pp. 193-202.

**Errata.**—The following correction should be made to the original paper:

Page 55, paragraph 5, line 7: Should read "All coalitions can be expressed as  $[\sum_{s \in N} (c_s - \bar{c}_s)/q_s]^p$ , in which  $p$  is a number" instead of "all coalitions can be expressed as  $\sum_{s \in N} [c_s - \bar{c}_s/q_s]^p$ , in which  $p$  is a number"

## LARGE-SCALE URBAN MODELING<sup>a</sup>

Closure by Otto J. Helweg,<sup>3</sup> M. ASCE

The writer thanks the discussor for pointing out the lack of implementing models in the public sector. There is no substantial disagreement between the writer and the discussor; however, two observations may be in order to expand the discussers point that the public sector does not use models developed by the academic community. First, it may be unfortunate that the academic community is not, in general, encouraged to emphasize applied research; basic research is given more credit when a professor's publishing record is being reviewed for promotion. Even if one does engage in applied research, there is a gap between the completed paper and applying the research to an actual situation. If there is no one to do this, the "completed" research may be acquired by an overworked public official who erroneously thinks that it is ready to use and then is disillusioned to find that considerable effort is required to apply it.

An interesting study might be to compare the use of modeling in the private sector with that in the public sector. Some have claimed that there is not incentive in the public sector to encourage modeling comparable to the profit motive which encourages modeling in the private sector. If this is true, it would indicate that modeling is useful, even if not always used.

The problems of academics not having incentive to apply their research, and the public sector not being rewarded for improved efficiency are long-standing questions with no immediate solutions in sight. The writer does, however, believe that models, both optimization and simulation, do hold significant potential benefits. Whether or not these benefits will soon be realized by the public sector is unknown.

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<sup>a</sup>November, 1979, by Otto J. Helweg (Proc. Paper 14947).

<sup>3</sup>Assoc. Prof., Dept. of Civ. Engrg., Univ. of California, Davis, Calif. 95616.

## NATIONAL GROWTH TRENDS<sup>a</sup>

Discussion by Dana Roberts<sup>2</sup> and John E. McLean,<sup>3</sup> M. ASCE

The author's conclusions and supporting comments appear generally sound, but one of his illustrations suggests a picture different than the actual situation. His conclusion that smaller nonmetropolitan cities are beginning to experience population increases while larger metropolitan areas are declining in population does appear to be true in New York State. Clifton Park, however, one of the municipalities cited, is not in the category of "smaller, nonmetropolitan cities," as is suggested by the author on page 35.

Clifton Park, and indeed all of Saratoga County in which it is located, is in the Albany-Troy-Schenectady SMSA. It is a bedroom community and an integral part of the larger metropolitan capital region. Clifton Park's rapid growth in the face of generally stable or declining populations in larger SMSA's is more analogous to the expansion of southern New Hampshire as a part of the greater Boston urban fringe.

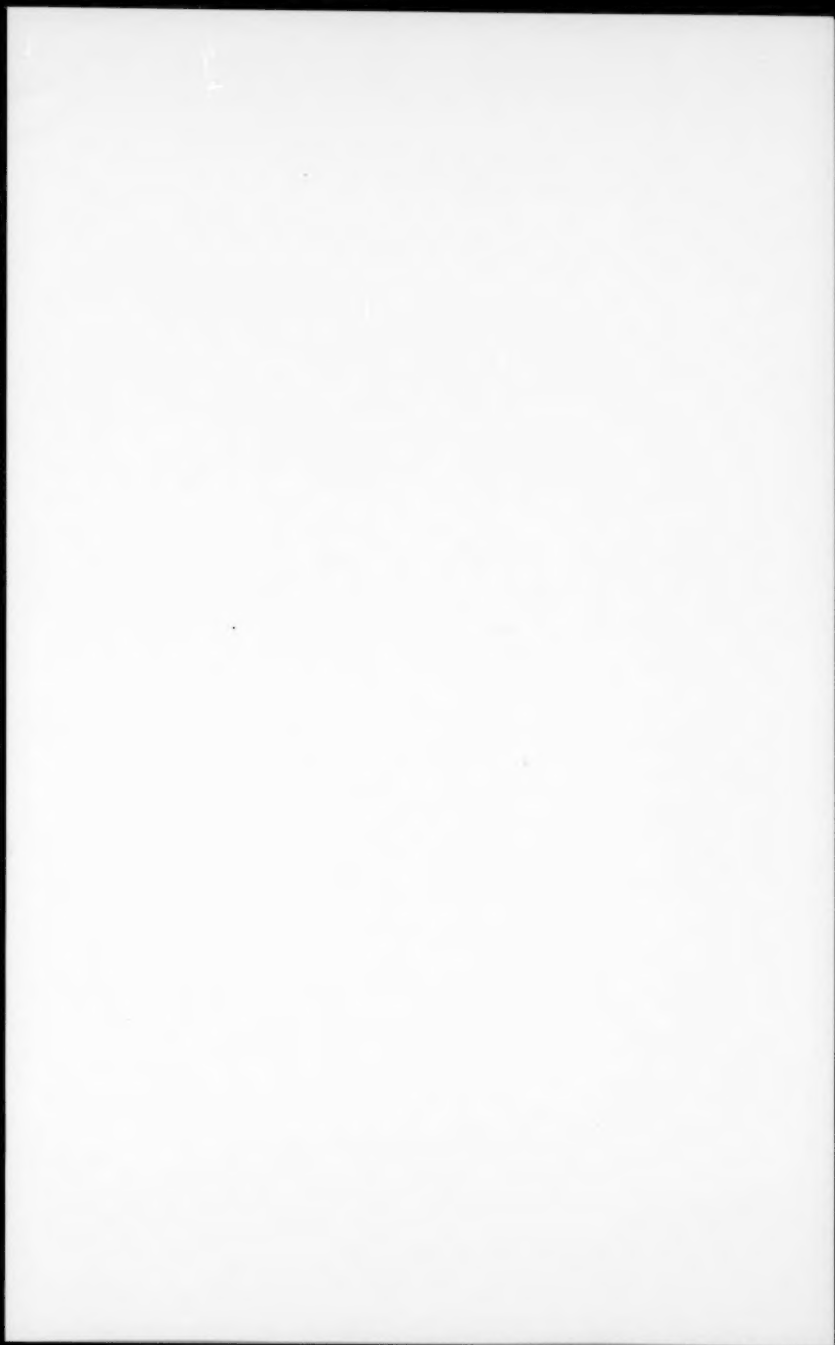
Our comments are not meant to detract from the author's well thought out paper, but rather, to set the record straight and at the same time note the difficulty of knowing local situations well enough to develop generalizations applicable to the entire country.

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<sup>a</sup>November, 1980, by Robert B. Seaman (Proc. Paper 15824).

<sup>2</sup>Chf., Transmission Facilities Planning and Certification Section, Office of Environmental Planning, New York State Dept. of Public Service, Albany, N.Y.

<sup>3</sup>Principal Water Resources Engr., Generating Facilities Planning and Certification Section, Office of Environmental Planning, New York State Department of Public Service, Albany, N.Y.



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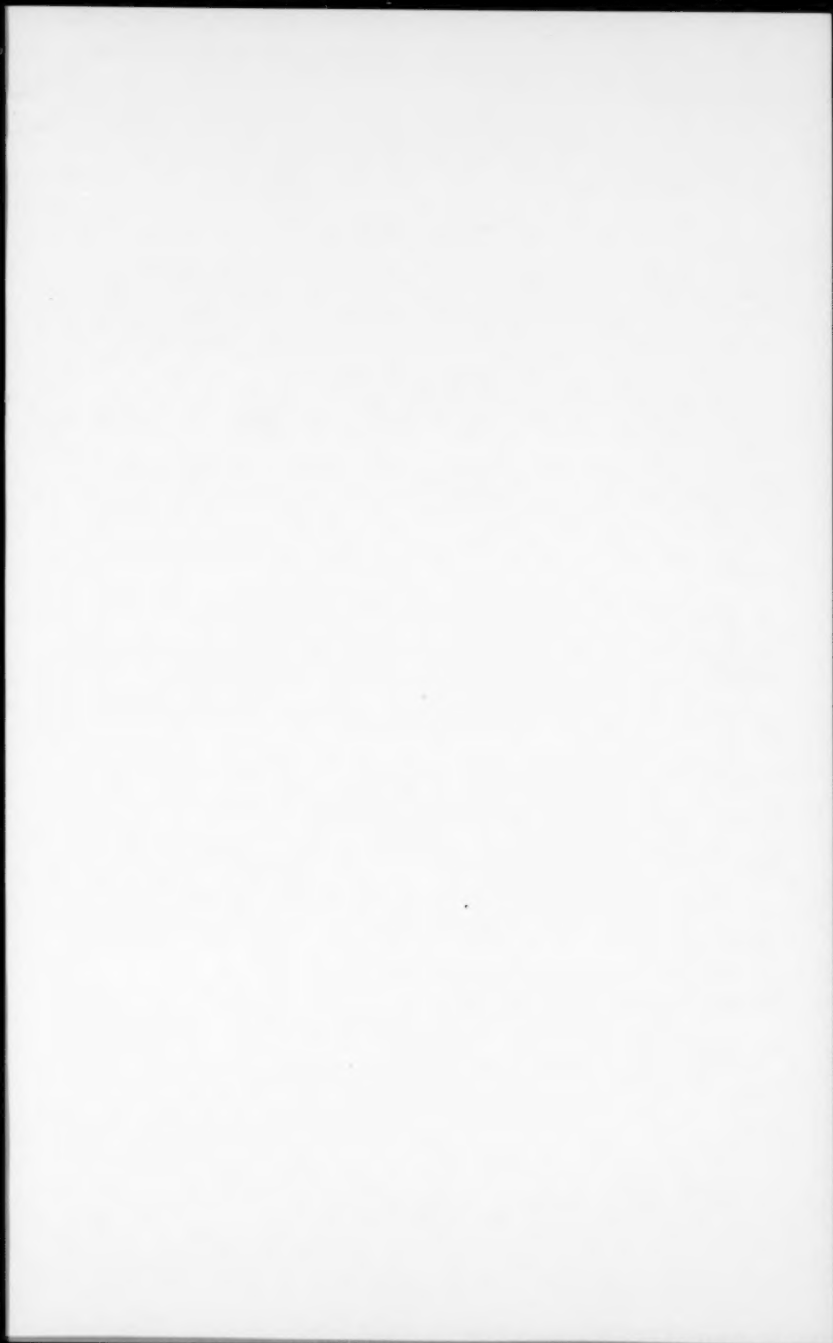
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11. A summary of approximately 40 words must accompany the paper.
12. A set of conclusions must end the paper.
13. Dual units, i.e., U.S. Customary followed by SI (International System) units in parentheses, should be used throughout the paper.
14. A practical applications section should be included also, if appropriate.





